LIQUID CRYSTAL DISPLAY DEVICE

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Abstract

PROBLEM TO BE SOLVED: To obtain a two-way display type liquid crystal display device which can obtain a display of nearly the same quality by both reflection using external light and transmission using illumination light.
SOLUTION: The two-way liquid crystal display device makes both a reflection display using external light and a transmission display using illumination light by arranging a lighting means 20 which emits the illumination light and reflects the external light made incident from before a liquid crystal display element 1 behind the liquid crystal display element 1. A display driving system 33 controls driving voltage with plural voltages applied selectively between electrodes of the liquid crystal display element 1 differently between the reflection display and transmission display so that the transmissivity of plural gradations corresponding to the driving voltages with the plural values for the reflection display is nearly equal to the transmissivity of plural gradations corresponding to the driving voltages with the plural values for the transmission display, for every plural gradations.

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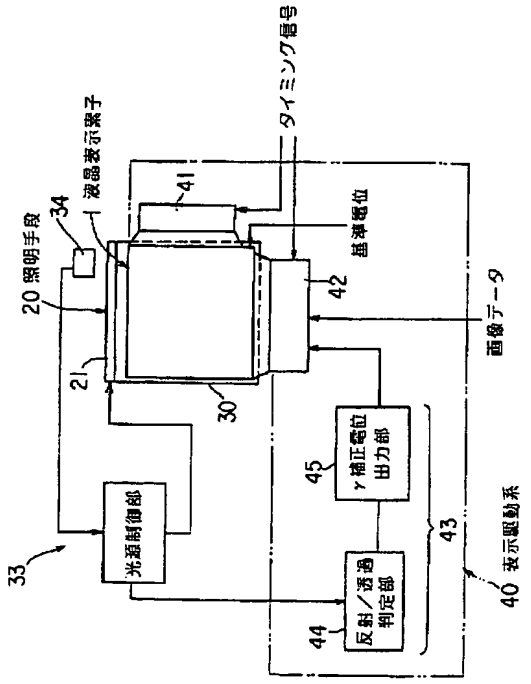
(54)【発明の名称】　液晶表示装置

(57)【要約】
【課題】外光を利用する反射表示のときも、照明光を利用する透過表示のときも、ほぼ同じ品位の表示を得ることができる２ウエイ表示型の液晶表示装置を提供する。
【解決手段】液晶表示素子1の背後に、照明光を出射するとともに液晶表示素子１の前方から入射する外光を反射する照明手段２０を配置して外光を利用する反射表示と照明光を利用する透過表示との両方の表示を行なう２ウエイ液晶表示装置において、表示駆動系３３により前記液晶表示素子１の電極間に選択的に印加する複数の値の駆動電圧を、反射表示のときと透過表示のときとで個別に制御し、前記反射表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率と、前記透過表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率とを、前記複数の階調ごとにほぼ等しくした。



【特許請求の範囲】
【請求項１】液晶層をはさんで対向する一対の基板の内面にそれぞれ電極が設けられた液晶表示素子と、前記液晶表示素子の背後に配置され、照明光を前記液晶表示素子に向けて出射するとともに前記液晶表示素子の前方から入射する外光を前記液晶表示素子に向けて反射する照明手段と、前記液晶表示素子の電極間に複数の値の駆動電圧を選択的に印加する表示駆動系とを備え、
前記液晶表示素子の前方から入射する外光を前記照明手段により反射し、その反射光を前記液晶表示素子の前方に出射させて表示する反射表示と、前記照明手段から照明光を出射させ、その光を前記液晶表示素子の前方に出射させて表示する透過表示との両方の表示を行なうとともに、
前記表示駆動系により前記液晶表示素子の電極間に選択的に印加する前記複数の値の駆動電圧を、前記反射表示のときと前記透過表示のときとで個別に制御し、前記反射表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率と、前記透過表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率とを、前記複数の階調ごとにほぼ等しくしたことを特徴とする液晶表示装置。
【請求項２】前記表示駆動系は、前記透過表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の透過表示のときの電圧－透過率特性に基づいて制御し、前記反射表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の透過表示のときの電圧－透過率特性と反射表示のときの電圧－透過率特性との差に基づいて制御することを特徴とする請求項１に記載の液晶表示装置。
【請求項３】前記表示駆動系は、前記反射表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の反射表示のときの電圧－透過率特性に基づいて制御し、前記透過表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の反射表示のときの電圧－透過率特性と透過表示のときの電圧－透過率特性との差に基づいて制御することを特徴とする請求項１に記載の液晶表示装置。
【請求項４】前記液晶表示素子は、その一方の基板の内面に、複数の画素電極と、これらの画素電極にそれぞれ接続された複数の薄膜トランジスタと、前記複数の薄膜トランジスタにそれぞれ接続された複数のゲートラインおよびデータラインが設けられ、他方の基板の内面に、前記複数の画素電極に対向する対向電極が設けられたアクティブマトリックス液晶表示素子であり、
前記表示駆動系は、前記複数のゲートラインに接続されたゲート側駆動回路と、前記複数のデータラインに接続されたデータ側駆動回路と、前記データ側駆動回路に前記複数の階調の透過率にそれぞれ対応する複数のγ補正電位を供給するγ補正電位供給手段とからなっており、
前記γ補正電位供給手段は、前記反射表示のときと前記透過表示のときとでそれぞれ異なる値の複数のγ補正電位を前記データ側駆動回路に供給し、
前記データ側駆動回路は、前記γ補正電位供給手段から供給される前記複数のγ補正電位のなかから画像データに対応するγ補正電位を選択し、その電位のデータ信号を前記データラインに供給することを特徴とする請求項１～３のいずれかに記載の液晶表示装置。
【請求項５】前記γ補正電位供給手段は、前記反射表示と前記透過表示の別を判定する反射／透過判定部と、この反射／透過判定部の判定結果に基づいて、前記反射表示のときの複数のγ補正電位と前記透過表示のときの複数のγ補正電位とのいずれかを前記データ側駆動回路に供給するγ補正電位出力部とからなっていることを特徴とする請求項４に記載の液晶表示装置。
【請求項６】前記γ補正電位出力部は、２通りの複数の基準電位を発生する基準電位発生回路と、この基準電位発生回路が発生する前記２通りの複数の基準電位のいずれかを前記反射／透過判定部の判定結果に基づいて選択し、その選択した複数の電位を前記複数のγ補正電位として前記データ側駆動回路に供給する電位選択回路とからなっていることを特徴とする請求項５に記載の液晶表示装置。
【請求項７】前記反射／透過判定部は、前記照明手段からの照明光の出射に連動して前記反射表示と前記透過表示の別を判定することを特徴とする請求項５または６に記載の液晶表示装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】この発明は、反射表示と透過表示との両方の表示を行なう２ウエイ表示型の液晶表示装置に関するものである。
【０００２】
【従来の技術】２ウエイ表示型の液晶表示装置は、液晶層をはさんで対向する一対の基板の内面にそれぞれ電極が設けられた液晶表示素子の背後に、照明光を前記液晶表示素子に向けて出射するとともに前記液晶表示素子の前方から入射する外光を前記液晶表示素子に向けて反射する照明手段を配置して構成されている。なお、前記照明手段としては、一般に、照明光を出射する照明パネルの前面に半透過反射板を配置したものが用いられている。
【０００３】前記２ウエイ液晶表示装置は、前記液晶表示素子の前方から入射する外光を前記照明手段により反射し、その反射光を前記液晶表示素子の前方に出射させて表示する反射表示と、前記照明手段から照明光を出射させ、その光を前記液晶表示素子の前方に出射させて表示する透過表示との両方の表示を行なうものであり、充分な明るさの外光が得られる環境下では、前記照明手段から照明光を出射させずに外光を利用する反射表示を行ない、充分な明るさの外光が得られない環境下では、前記照明手段から照明光を出射させてその照明光を利用す

る透過表示を行なう。

【０００４】前記照明光を利用する透過表示は、液晶表示装置の使用環境の照度が所定の照度以下であるとき、つまり、外光を利用する反射表示だけでは充分な画面輝度が得られないときに行なわれ、このような照度の環境下において前記照明手段から照明光を出射させると、外光を利用する反射表示による画面の輝度不足が、照明光を利用する透過表示の併用により補われる。また、外光が得られない暗い環境下では、照明光を利用する透過表示だけになる。

【０００５】

【発明が解決しようとする課題】しかし、従来の２ウエイ液晶表示装置は、外光を利用する反射表示のときの表示品位と、照明光を利用する透過表示のときの表示品位とが異なるという問題をもっている。

【０００６】これは、外光を利用する反射表示のときの光の透過経路と、照明光を利用する透過表示のときの光の透過経路との違いによるものであり、反射表示のときは、液晶表示素子の前方から入射した外光が前記液晶表示素子を透過してその背後の照明手段により反射され、その反射光が前記液晶表示素子を再び透過して前方に出射するのに対し、透過表示のときは、前記照明手段からの照明光が前記液晶表示素子にその背面から入射し、この液晶表示素子を透過して前方に出射するため、前記液晶表示素子は、外光を利用する反射表示のときと、照明光を利用する透過表示のときとで、異なる電圧－透過率特性を示す。

【０００７】一方、前記液晶表示素子は、液晶層をはさんで対向する一対の基板の内面にそれぞれ設けられた電極間に、あらかじめ設定された複数の値の駆動電圧を選択的に印加することにより表示駆動されている。

【０００８】しかし、上記のように、液晶表示素子は、外光を利用する反射表示のときと、照明光を利用する透過表示のときとで、異なる電圧－透過率特性を示すため、前記電極間に印加される駆動電圧に対する透過率が、前記反射表示のときと前記透過表示のときとで異なり、反射表示のときの表示品位と、照明光を利用する透過表示のときの表示品位とが異なってしまう。

【０００９】この発明は、外光を利用する反射表示のときも、照明光を利用する透過表示のときも、ほぼ同じ品位の表示を得ることができる２ウエイ表示型の液晶表示装置を提供することを目的としたものである。

【００１０】

【課題を解決するための手段】この発明の液晶表示装置は、液晶層をはさんで対向する一対の基板の内面にそれぞれ電極が設けられた液晶表示素子と、前記液晶表示素子の背後に配置され、照明光を前記液晶表示素子に向けて出射するとともに前記液晶表示素子の前方から入射する外光を前記液晶表示素子に向けて反射する照明手段と、前記液晶表示素子の電極間に複数の値の駆動電圧を選択的に印加する表示駆動系とを備え、前記液晶表示素子の前方から入射する外光を前記照明手段により反射し、その反射光を前記液晶表示素子の前方に出射させて表示する反射表示と、前記照明手段から照明光を出射させ、その光を前記液晶表示素子の前方に出射させて表示する透過表示との両方の表示を行なうとともに、前記表示駆動系により前記液晶表示素子の電極間に選択的に印加する前記複数の値の駆動電圧を、前記反射表示のときと前記透過表示のときとで個別に制御し、前記反射表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率と、前記透過表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率とを、前記複数の階調ごとにほぼ等しくしたことを特徴とするものである。

【００１１】この発明の液晶表示装置によれば、外光を利用する反射表示のときも、照明光を利用する透過表示のときも、ほぼ同じ品位の表示を得ることができる。

【００１２】

【発明の実施の形態】この発明の液晶表示装置は、上記のように、液晶表示素子の電極間に選択的に印加する前記複数の値の駆動電圧を、反射表示のときと透過表示のときとで個別に制御し、前記反射表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率と、前記透過表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率とを、前記複数の階調ごとにほぼ等しくすることにより、外光を利用する反射表示のときも、照明光を利用する透過表示のときも、ほぼ同じ品位の表示を得ることができるようにしたものである。

【００１３】この発明の液晶表示装置において、前記表示駆動系は、例えば、前記透過表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の透過表示のときの電圧－透過率特性に基づいて制御し、前記反射表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の透過表示のときの電圧－透過率特性と反射表示のときの電圧－透過率特性との差に基づいて制御するように構成すればよく、このようにすることにより、反射表示のときの表示品位を、透過表示のときの表示品位とほぼ等しくすることができる。

【００１４】また、前記液晶表示素子の表示駆動系は、前記反射表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の反射表示のときの電圧－透過率特性に基づいて制御し、前記透過表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の反射表示のときの電圧－透過率特性と透過表示のときの電圧－透過率特性との差に基づいて制御するように構成してもよく、このようにすることにより、透過表示のときの表示品位を、反射表示のときの表示品位とほぼ等しくすることができる。

【００１５】この発明の液晶表示装置において、前記液晶表示素子が、その一方の基板の内面に、複数の画素電極と、これらの画素電極にそれぞれ接続された複数の薄

膜トランジスタと、前記複数の薄膜トランジスタにそれぞれ接続された複数のゲートラインおよびデータラインが設けられ、他方の基板の内面に、前記複数の画素電極に対向する対向電極が設けられたアクティブマトリックス液晶表示素子である場合、前記表示駆動系は、前記複数のゲートラインに接続されたゲート側駆動回路と、前記複数のデータラインに接続されたデータ側駆動回路と、前記データ側駆動回路に前記複数の階調の透過率にそれぞれ対応する複数のγ補正電位を供給するγ補正電位供給手段とからなり、前記γ補正電位供給手段が、前記反射表示のときと前記透過表示のときとでそれぞれ異なる値の複数のγ補正電位を前記データ側駆動回路に供給し、前記データ側駆動回路が、前記γ補正電位供給手段から供給される前記複数のγ補正電位のなかから画像データに対応するγ補正電位を選択して、その電位のデータ信号を前記データラインに供給する構成とすればよく、このように前記表示駆動系を構成することにより、前記アクティブマトリックス液晶表示素子の表示品位を、外光を利用する反射表示のときも、照明光を利用する透過表示のときも、ほぼ同じにすることができる。

【００１６】この場合、前記γ補正電位供給手段は、前記反射表示と前記透過表示の別を判定する反射／透過判定部と、この反射／透過判定部の判定結果に基づいて、前記反射表示のときの複数のγ補正電位と前記透過表示のときの複数のγ補正電位とのいずれかを前記データ側駆動回路に供給するγ補正電位出力部とにより構成するのが望ましく、このようにすることにより、反射表示と透過表示の別に応じて、前記データ側駆動回路に供給するγ補正電位を自動的に切換えることができる。

【００１７】さらに、前記γ補正電位出力部は、２通りの複数の基準電位を発生する基準電位発生回路と、この基準電位発生回路が発生する前記２通りの複数の基準電位のいずれかを前記反射／透過判定部の判定結果に基づいて選択し、その選択した複数の電位を前記複数のγ補正電位として前記データ側駆動回路に供給する電位選択回路とにより構成するのが好ましく、このようにすることにより、前記データ側駆動回路に供給するγ補正電位を、反射表示と透過表示の別に応じて確実に切換えることができる。

【００１８】また、前記反射／透過判定部は、前記照明手段からの照明光の出射に連動して前記反射表示と前記透過表示の別を判定するように構成するのが望ましく、このようにすることにより、反射表示と透過表示の別を信頼性良く判定し、その表示のときのγ補正電位を前記データ側駆動回路に供給することができる。

【００１９】

【実施例】図１～図６はこの発明の一実施例を示しており、図１は液晶表示装置の基本構成図、図２は図１におけるγ補正電位出力部の詳細図、図３は液晶表示装置の具体的な構成を示す側面図、図４は図３の一部分の拡大図、図５はこの実施例の液晶表示装置に用いた液晶表示素子の一部分の断面図である。

【００２０】この実施例の液晶表示装置は、図１および図３に示すように、液晶表示素子１と、この液晶表示素子１の背後に配置され、照明光を前記液晶表示素子１に向けて出射するとともに前記液晶表示素子１の前方から入射する外光を前記液晶表示素子１に向けて反射する照明手段２０と、前記液晶表示素子１の表示駆動系４０とを備えている。

【００２１】まず、前記液晶表示素子１について説明すると、この実施例で用いた液晶表示素子１は、フルカラー画像等の多色カラー画像を表示するアクティブマトリックス液晶表示素子であり、図５に示すように、液晶層１０をはさんで対向する前面側および背面側の一対の透明基板２，３のうちの一方の基板、例えば背面側基板３の内面には、行方向および列方向にマトリックス状に配列する複数の透明な画素電極４と、これらの画素電極４にそれぞれ接続された複数の薄膜トランジスタ（以下、ＴＦＴと記す）５と、前記複数のＴＦＴ５にそれぞれ接続された複数のゲートラインおよびデータライン（いずれも図示せず）が設けられている。

【００２２】なお、図５では前記ＴＦＴ５を簡略化して示しているが、このＴＦＴ５は、基板３上に形成されたゲート電極と、このゲート電極を覆って基板３のほぼ全面に形成された透明なゲート絶縁膜と、このゲート絶縁膜の上に前記ゲート電極に対向させて設けられたｉ型半導体膜と、このｉ型半導体膜の両側部の上にｎ型半導体膜を介して形成されたソース電極およびドレイン電極とからなっている。

【００２３】また、図示しない前記ゲートラインは、前記基板３上に各画素電極行の一側にそれぞれ沿わせて配線されており、前記ＴＦＴ５のゲート電極は、前記ゲートラインに一体に形成されている。なお、このゲートラインも、その端子部を除いて前記ゲート絶縁膜により覆われている。

【００２４】一方、図示しない前記データラインは、前記ゲート絶縁膜の上に各画素電極列の一側にそれぞれ沿わせて配線されており、前記ＴＦＴ５のドレイン電極は前記データラインに接続され、ソース電極は前記画素電極４に接続されている。

【００２５】また、前面側基板２の内面には、複数の色の着色膜、例えば赤、緑、青の３色のカラーフィルタ７Ｒ，７Ｇ，７Ｂが、前記複数の画素電極４にそれぞれ対応させて交互に並べて設けられており、その上に、前記複数の画素電極４の全てに対向する一枚膜状の透明な対向電極８が設けられている。

【００２６】なお、この液晶表示素子１は、ＴＮ（ツイステッドネマティック）型のものであり、前記液晶層１０の液晶分子は、前記一対の基板２，３の内面にそれぞれ設けられた配向膜９，６によりこれらの基板２，３の

近傍における配向方向を規制されて、両基板２，３間において所定のツイスト角（例えばほぼ９０度）でツイスト配向しており、また前記一対の基板２，３の外面にはそれぞれ偏光板１１，１２が、その透過軸を所定の方向に向けて配置されている。

【００２７】前記液晶表示素子１の表示駆動系４０は、前記液晶表示素子１の対向電極８を基準電位に接続し、前記複数のゲートラインにゲート信号を供給するとともに、前記複数のデータラインにデータ信号を供給することにより、前記複数の画素電極４と対向電極８との間にそれぞれ複数の値の駆動電圧を選択的に印加して、前記液晶表示素子１を表示駆動する。

【００２８】この前記表示駆動系４０は、図１に示したように、前記液晶表示素子１の複数のゲートラインに接続されたゲート側駆動回路４１と、前記液晶表示素子１の複数のデータラインに接続されたデータ側駆動回路４２と、前記データ側駆動回路４２に複数の階調の透過率にそれぞれ対応する複数のγ補正電位を供給するγ補正電位供給手段４３とからなっている。

【００２９】前記ゲート側駆動回路４１は、前記ＴＦＴ５をオンさせる電位になる選択期間を前記タイミング信号に同期させて順次ずらした波形のゲート信号を前記複数のゲートラインに供給する。

【００３０】また、前記データ側駆動回路４２は、前記γ補正電位供給手段４３から供給される前記複数のγ補正電位のなかから、外部から供給される画像データに対応するγ補正電位を選択し、その電位のデータ信号を前記タイミング信号に同期させて前記複数のデータラインに供給する。

【００３１】そして、前記複数のデータラインに供給されたデータ信号は、前記ゲート信号により各行ごとに順次オンされるＴＦＴ５を介して各列の画素電極４に供給され、これらの画素電極４と前記基準電位に接続された対向電極８との間に、前記データ信号の電位、つまり前記画像データに対応するγ補正電位に応じた駆動電圧が印加される。

【００３２】次に、前記液晶表示素子１の背後に配置された照明手段２０について説明すると、この照明手段２０は、図３および図４に示したように、照明光を発する光源２１と、この光源２１からの照明光を端面から取り込んで前方に出射するとともに前記液晶表示素子１の前方から入射する外光を前方に反射する導光体２４と、この導光体２４の前面側に配置された光学部材３０とにより構成されている。

【００３３】前記導光体２４は、アクリル系樹脂等からなる透明板であり、その一端面が前記光源２１からの光を取り込む入射端面２５となっている。また、この導光体２４の前面は、前記入射端面２５側から他端側に向かって段階的に低くなる（導光体背面との間隔を狭める）ように形成された互いに平行な複数の段面２６と、これらの段面２６をつなぐ複数の段差面２７とからなる微小ピッチの階段形状面に形成されており、背面には、鏡面反射板２９が設けられている。

【００３４】前記階段形状面の複数の段差面２７は、前記入射端面２５とほぼ平行な面であり、これらの段差面２７の間の前記段面２６は、導光体２４の幅方向（入射端面２５の長さ方向）に沿う横長の平坦面である。

【００３５】そして、前記導光体２４の前記複数の段面２６上にはそれぞれ、その全面にわたってアルミニウム等の高反射率金属の蒸着膜からなる鏡面反射膜２８が設けられており、これらの反射膜２８により、前記液晶表示素子１の前方から入射する外光を前方に反射する外光反射面が形成されている。

【００３６】また、前記導光体２４の前記複数の段差面２６は、反射膜を形成しない光透過面とされており、これらの段差面２６がそれぞれ、前記入射端面２５から入射した照明光の出射面となっている。

【００３７】前記光源２１は、例えば、前記導光体２４の入射端面２５の全長にわたる長さの直管状蛍光ランプ２２、この蛍光ランプ２２からの放射光を前記導光体２４の入射端面２５に向けて反射するリフレクタ２３とからなっており、この光源２１は、前記導光体２４の側方に、その入射端面２５に対向させて配置されている。

【００３８】一方、前記光学部材３０は、その前面から入射する光を背面に出射するとともに前記導光体２４の複数の段面２６上の反射膜２８により反射されてこの光学部材３０の背面から入射する光を前面に出射し、前記導光体２４の複数の段差面（出射面）２７から出射する照明光を、背面から取り込んで前方に出射する特性を有している。

【００３９】この光学部材３０は、前記導光体２４とほぼ同じ横幅を有するアクリル系樹脂等からなる透明板であり、その前面は平坦面とされ、背面には、前記導光体２４の階段形状面の複数の段差面２７から出射する光を取り込むための複数の入射部３１が一体に設けられている。

【００４０】これらの入射部３１は、光学部材３０の横幅全長にわたって形成された三角形状の断面形状を有する横長の突起からなっており、前記光学部材３０は、その背面の複数の入射部３１の長さ方向を前記導光体２４の複数の段差面２７の長さ方向とほぼ平行にするとともに、前記複数の入射部３１の頂部を前記導光体２４の複数の段面２６上の反射膜２８に近接または当接させて配置されている。

【００４１】そして、前記複数の入射部３１の両側面のうち、前記導光体２４の段差面２７に対向する一方の側面は、前記段差面２７から出射する光を取り込む入射面３１ａとなっており、他方の側面は、前記入射面３１ａから取り込んだ光を光学部材３０の前面方向に向けて屈折させる屈折面３１ｂとなっている。

【００４２】前記入射面３１ａは、前記導光体２４の段差面２７とほぼ平行またはそれに近い傾きをもった面であり、前記屈折面３１ｂは、光学部材３０の前面の法線とのなす角度が、前記入射面３１ａと前記法線とのなす角度よりも大きな傾斜角度をもつ傾斜面である。

【００４３】なお、前記入射部３１の望ましい形状は、入射面３１ａが前記法線に対して前記導光体２４の段差面２７に向き合う方向に５～１５度傾斜し、屈折面３１ｂが前記法線に対して反対方向に２０～５０度傾斜した形状である。

【００４４】また、前記複数の入射部３１は、それぞれの間に間隔を存して一定のピッチで設けられており、前記光学部材３０の隣接する入射部３１の間の背面領域は、前記導光体２４の複数の段面２６上の反射膜２８に対向する入出射面３２となっている。

【００４５】この入出射面３２は、液晶表示素子１の前方から入射し、前記導光体２４の複数の段面２６上の反射膜２８により反射されて前方に出射する光を透過させるための面であり、前記導光体２４の段面２６とほぼ平行またはそれに近い傾きをもっている。

【００４６】さらに、前記光学部材３０の複数の入射部３１は、前記導光体２４の段差面２７のピッチよりも小さいピッチで設けられており、したがって、前記導光体２４の複数の段差面２７は、そのそれぞれが、前記光学部材の３０の少なくとも１つの入射部３１に必ず対向している。

【００４７】なお、図3および図４では、便宜上、導光体２４の階段形状面および光学部材３０の複数の入射部３１とその間の入出射面３２を大きく拡大して示したが、前記光学部材３０の入射部３１のピッチは、液晶表示素子１の画素領域（複数の画素電極４と対向電極８とが互いに対向する領域）のピッチとほぼ同じか、あるいはそれよりも小さく設定されており、この光学部材３０の入射部３１のピッチに応じて、前記導光体２４の段差面２７のピッチが、前記光学部材３０の入射部３１のピッチよりも若干大きく設定されている。

【００４８】そして、この実施例の液晶表示装置では、上記光源２１と導光体２４と光学部材３０とからなる照明手段２０を、前記光学部材３０の複数の入射部３１の長さ方向および導光体２４の複数の段差面２７の長さ方向を液晶表示素子１の画面の横軸とほぼ平行にするとともに、前記光源２１の配置側を外光の主な取り込み方向に向けて、前記液晶表示素子１の背後に配置している。

【００４９】すなわち、一般に、反射型の液晶表示装置は、画面の法線に対して前記画面の上縁側に傾いた方向から主に外光を取り込むように画面の向きを選んで使用される。

【００５０】そのため、この実施例では、上記照明手段２０を、光源２１の配置側を外光の主な取り込み方向である画面の上縁側、つまり液晶表示素子１の上縁側（図3において左側）に向けて配置している。

【００５１】また、上記照明手段２０は、この照明手段２０からの照明光の出射を制御する照明制御手段３３を備えており、液晶表示装置の使用環境の照度が所定値以下になったときに、自動的に照明光を出射するとともに、その照明光の輝度を、前記環境の照度に応じて制御する。

【００５２】前記照明制御手段３３は、図１および図３に示すように、環境照度を測定する照度検出器３４と、光源制御部３５とからなっており、前記照度検出器３４は、液晶表示素子１にその前方から入射する外光の照度と同じ環境照度を測定するように、受光面を前記液晶表示素子１の前面とほぼ平行にしてこの液晶表示素子１の近傍に配置されている。

【００５３】前記光源制御部３５は、前記照度検出器３４により測定された環境照度に基づいて、前記光源２１の点灯およびその出射輝度を制御するものであり、前記環境照度が予め設定された所定の照度（外光を利用する反射表示だけでは充分な画面輝度が得られない照度）以下であるときに、前記光源２１を点灯させるとともに、この光源２１の出射輝度を、前記液晶表示素子１の画面輝度が環境照度に応じて予め定められた輝度範囲となるように制御する。

【００５４】この液晶表示装置は、液晶表示素子１の前方から入射する外光を前記照明手段２０により反射し、その反射光を前記液晶表示素子１の前方に出射させて表示する反射表示と、前記照明手段２０から照明光を出射させ、その光を前記液晶表示素子１の前方に出射させて表示する透過表示との両方の表示を行なう２ウエイ表示型のものであり、充分な明るさの外光が得られる環境下では、前記照明手段２０から照明光を出射させずに外光を利用する反射表示を行ない、充分な明るさの外光が得られない環境下では、前記照明手段２０から照明光を出射させてその照明光を利用する透過表示を行なう。

【００５５】まず、前記反射表示のときの外光の出射経路を説明すると、外光は、その経路を図４に実線で示したように、液晶表示素子１にその前方から入射し、この液晶表示素子１を透過して前記照明手段２０により反射され、再び前記液晶表示素子１を透過して前方に出射する。

【００５６】すなわち、反射表示のときは、液晶表示素子１にその前方から入射し、この液晶表示素子１を透過してその背面に出射した外光が、前記照明手段２０の前面部材である光学部材３０にその前面から入射し、この光学部材３０を透過してその背面に出射し、前記導光体２４の複数の段面２６上の反射膜２８により反射される。

【００５７】なお、この液晶表示装置では、上述したように、前記照明手段２０を、光源２１の配置側を液晶表示装置の外光の主な取り込み方向である画面の上縁側に

向けて配置しているため、液晶表示素子１を透過した外光は、主に前記光源２１の配置側から前記光学部材３０に入射するが、その入射角は様々である。

【００５８】そのため、前記光学部材３０にその前面から入射した外光は、この光学部材３０内をその背面に向かって様々な方向に進むが、その入射光のうち、光学部材背面の複数の入射部３１の傾斜角が大きい屈折面３１ｂと、隣接する入射部３１の間の入出射面３２に向かう光は、これらの面３１ｂ，３２と外気（導光体２４と光学部材３０との間の空気層）との界面を透過して背面に出射し、前記導光体２４の段面２６上の反射膜２８により反射される。

【００５９】また、前記入射光のうち、前記入射部３１の傾斜角が小さい入射面３１ａに向かう光は、その経路は図示しないが、この入射面３１ａと外気との界面で全反射されて向きを変え、前記屈折面３１ｂまたは入出射３２から背面に出射して、前記導光体２４の段面２６上の反射膜２８により反射される。

【００６０】前記導光体２４の複数の段面２６上の反射膜２８により反射された反射光は、前記光学部材３０にその背面から取り込まれ、この光学部材３０を透過してその前面から出射する。

【００６１】このとき、前記導光体２４の段面２６と前記光学部材３０の複数の入射部３１の入射面３１ａとのなす角度が大きい（直角に近い）ため、導光体２４の段面２６上の反射膜２８により反射された反射光は、そのほとんどが光学部材３０の複数の入射部３１の屈折面３１ｂおよび前記入出射面３２から取り込まれる。

【００６２】そして、前記入射部３１の屈折面３１ｂから取り込まれた光のうちの直接光学部材３０の前面に向かう光と、前記入出射面３２から取り込まれた光は、その向きのまま光学部材３０を透過してその前面から出射し、前記入射部３１の屈折面３１ｂから取り込まれた光のうち、反対側の入射面３１ａに向かう光は、この入射面３１ａと外気との界面で全反射されて向きを変え、前記屈折面３１ｂおよび入出射面３２から直接光学部材３０の前面に向かう光の方向に近い方向に向きを変えて光学部材３０の前面から出射する。

【００６３】そのため、前記照明手段２０の前面（光学部材３０の前面）に出射する外光の反射光は、様々な入射角で入射した外光が正面方向（光学部材３０の前面の法線の近傍の方向）に集光された高輝度の光であり、したがって、この外光の反射光は、正面方向に出射する光の輝度が高い輝度分布の光である。

【００６４】すなわち、前記光学部材３０の前面に出射する外光の反射光は、前記入射部３１から入射して正面方向に集光された輝度分布の光に、前記入射部３１の間の入出射面３２から入射して前面方向に透過した光が重畳した、正面方向に出射する光の輝度が高い輝度分布の光である。

【００６５】そして、前記照明手段２０の前面から出射した前記反射光は、前記液晶表示素子１にその背面から入射し、この液晶表示素子１を再び透過してその前面から前方に出射する。

【００６６】なお、前記液晶表示素子１は、複数の画素電極４にそれぞれ対応する赤、緑、青のカラーフィルタ７Ｒ，７Ｇ，７Ｂを備えているため、前記複数の画素電極４と対向電極８とが互いに対向する複数の画素領域から出射する光は、赤、緑、青の着色光であり、これらの着色光の出射強度が、その画素領域の電極４，８間に印加される駆動電圧に応じた液晶分子の配向変化により制御され、前記複数の画素領域からそれぞれ出射する様々な階調の赤、緑、青の着色光の混色によりフルカラー等の多色カラー画像が表示される。

【００６７】次に、透過表示のときの照明光の出射経路を説明すると、前記照明手段２０の光源２１は、前記透過表示を行なうときに点灯される。

【００６８】この光源２１からの照明光は、前記導光体２４にその入射端面２５から取り込まれて導光体２４内をその長さ方向に導かれ、図４に破線で示した経路のように、導光体前面の複数の段差面２７のいずれから出射する。

【００６９】なお、前記導光体２４にその入射端面２５から取り込まれた照明光は、導光体２４内を様々な方向に向かって進むが、そのうちの前記複数の段差面２７に直接向かう光は、その段差面２７から出射する。

【００７０】また、前記段差面２７に直接向かう光以外の光、つまり、前記複数の段差面２７の間の段面２６に向かって進む光や、導光体２４の背面に向かって進む光は、前記段面２６上の反射膜２８の裏面や、導光体背面に設けられた反射膜２９により反射されて向きを変え、前記複数の段差面２７のいずれかに入射して、その段差面２７から出射する。

【００７１】そのため、前記導光体２４にその入射端面２５から取り込まれた照明光のほとんどが、無駄なく前記複数の段差面２７から出射する。

【００７２】前記導光体２４の複数の段差面２７から出射した照明光は、前記導光体２４の前面側に配置された光学部材３０の背面の複数の入射部３１に、その一側面の入射面３１ａから入射する。

【００７３】このとき、前記導光体２４の複数の段差面２７は、そのそれぞれが前記光学部材の３０の少なくとも１つの入射部３１に必ず対向しているため、前記導光体２４の複数の段差面２７から出射した照明光のほとんどが、無駄なく光学部材３０のいずれかの入射部３１に入射する。

【００７４】なお、前記導光体２４の複数の段差面２７から出射する照明光のなかには、図４に示したように、次の段面２６に向かって出射する光もあるが、その光は、前記次の段面２６上の反射膜２８により反射されて

前記光学部材３０の入射部３１に入射する。

【００７５】前記光学部材３０の複数の入射部３１にその一側面の入射面３１ａから入射した照明光は、前記入射面３１ａとは反対側の屈折面３１ｂと外気（導光体２４と光学部材３０との間の空気層）との界面で全反射されて光学部材３０の前面方向に向きを変え、この光学部材３０を透過してその前面から出射する。

【００７６】この光学部材３０の前面に出射する照明光は、前記複数の入射部３１にその一側面の入射面３１ａから入射し、反対側の屈折面３１ｂにより屈折されて所定の方向に集光した、所定方向の輝度が高い輝度分布の光である。

【００７７】この実施例では、前記入射部３１の屈折面３１ｂの傾斜角を、この屈折面３１ｂで屈折された光の向きが正面方向になるように設定しており、したがって、光学部材３０の前面に出射する照明光は、正面方向の輝度が高い指向性をもった分布の光である。この光学部材３０の前面に出射する照明光の出射方向は、前記入射部３１の屈折面３１ｂの傾斜角に応じた方向であり、前記屈折面３１ｂの傾斜角が光学部材３０の前面の法線に対して２０～５０度の範囲であるときに、より正面方向に近くなる。

【００７８】そして、前記光学部材３０の前方に出射した光、つまり照明手段２０から出射した照明光は、液晶表示素子１にその背面から入射し、この液晶表示素子１を透過してその前面から前方に出射する。

【００７９】この透過表示のときも、前記液晶表示素子１の複数の画素領域から出射する光は、赤、緑、青の着色光であり、これらの着色光の出射強度が、その画素領域の電極４，８間に印加される駆動電圧に応じた液晶分子の配向変化により制御され、前記複数の画素領域からそれぞれ出射する様々な階調の赤、緑、青の着色光の混色によりフルカラー等の多色カラー画像が表示される。

【００８０】前記照明光を利用する透過表示は、環境照度が所定の照度以下であるとき、つまり、外光を利用する反射表示だけでは充分な画面輝度が得られないときに行なわれ、このような照度の環境下において前記照明手段２０から照明光を出射させると、外光を利用する反射表示による画面の輝度不足が、照明光を利用する透過表示の併用により補われる。なお、外光が得られない暗い環境下では、照明光を利用する透過表示だけになる。

【００８１】すなわち、この液晶表示装置は、充分な明るさの外光が得られる環境下では前記照明手段２０から照明光を出射させずに外光を利用する反射表示を行ない、外光の明るさが不足するときに、前記照明手段２０から照明光を出射させて画面輝度を補うものである。

【００８２】この液晶表示装置における液晶表示素子１の画面輝度について説明すると、液晶表示装置の好適な画面輝度は、環境照度によって異なり、同じ画面輝度でも、環境照度によっては画面が眩しすぎたり暗すぎたりする。

【００８３】そのため、この液晶表示装置では、例えば夏期の直射日光下のような１００００ルクスを超える高照度の環境下でも、眩しすぎない好適な画面輝度が得られるように、主に前記照明手段２０の外光の反射率（導光体２４の複数の段面２６上の反射膜２８の反射率）と液晶表示素子１の光の透過率とによって決まる液晶表示装置の反射率（液晶表示素子１の前方から入射する外光の強度に対する照明手段２０により反射されて前記液晶表示素子１の前方に出射する出射光の強度との比）を、外光の反射光のみを利用する通常の反射型液晶表示装置に比べて低く設定し、また、液晶表示素子１の前方から入射して前記照明手段２０により反射される外光の反射光と、前記照明手段２０が出射する照明光との両方による画面輝度（ただし、環境照度がほとんど０ルクスであるときは、照明手段２０が出射する照明光のみによる画面輝度）が、環境照度に応じた好適な画面輝度になるように、前記照明手段２０が出射する照明光の輝度を、環境照度に応じて制御するようにしている。

【００８４】環境照度に応じた好適な画面輝度は、例えば夜間の街灯下のような５０ルクスの環境照度で２０～２００ニット、昼間や夜間の室内照明を点灯させたときの室内のような１０００ルクスの環境照度で３０～３００ニット、晴天時の木陰のような３００００ルクスの環境照度で４００～４０００ニット であり、より好ましくは、５０ルクスの環境照度で２０～６０ニット、１０００ルクスの環境照度で６０～２００ニット、３００００ルクスの環境照度で１０００～３０００ニットである。

【００８５】そこで、この実施例では、前記照明手段２０が出射する照明光の輝度を、前記照明制御手段３３により、環境照度に対する画面輝度が、５０ルクスの環境照度で２０～３００ニット（より好ましくは２０～６０ニット）、１０００ルクスの環境照度で３０～３００ニット（より好ましくは６０～２００ニット）、３００００ルクスの環境照度で４００～４０００ニット（より好ましくは１０００～３０００ニット）の範囲をそれぞれ満足する二次関数で表わされる輝度となるように、環境照度に応じて制御するようにしている。

【００８６】そのため、この液晶表示装置は、暗い環境下でも好適な画面輝度が得られるし、また、液晶表示装置の反射率が、外光の反射光のみを利用する通常の反射型液晶表示装置に比べて低くてよいため、夏期の直射日光下のような高照度の環境下でも、眩しすぎることのない好適な画面輝度を得ることができる。

【００８７】また、この液晶表示装置は、環境照度がほとんど０ルクスであるとき、つまり外光がほとんど得られないときでも、前記照明手段２０が出射する照明光を利用して好適な画面輝度の表示を行なうことができる。

【００８８】前記照明光の輝度は、外光の反射光と前記

照明光との両方による画面輝度が、環境照度に対して好適な輝度になる値であればよく、その条件で前記照明手段から出射させる照明光の輝度を制御すればよいため、前記照明手段２０の消費電力は少なくてよい。

【００８９】したがって、この液晶表示装置は、消費電力が少なくてすみ、しかも、低照度から高照度の広い照度範囲の環境において、その環境照度に対して好適な画面輝度を得ることができる。

【００９０】なお、前記照明制御手段３３は、室内照度（１０００ルクス付近）よりも高い環境照度において、照明光の輝度を上述した条件で制御するのが望ましく、このようにすることにより、室内照度よりも高い照度の環境下において、その環境照度に対してより好適な画面輝度を得ることができる。

【００９１】この場合、室内照度以下の環境照度では、前記照明光の輝度を一定に保つようにしてもよく、その場合でも、上記条件を満足するように照明光の輝度を設定すれば、室内照度以下の環境下においても、環境照度に対して好適な画面輝度を得ることができる。

【００９２】ただし、前記照明制御手段３３は、室内照度以下の環境照度でも、照明光の輝度を、環境照度が低くなるのにともなって連続的に低くなるように制御するのが望ましく、このようにすることにより、室内照度よりも低い照度範囲の環境下での画面輝度をより好適にするとともに、前記照明手段２０の消費電力をさらに少なくすることができる。

【００９３】また、上記実施例では、前記照明制御手段３３を、環境照度を測定する照度検出器３４と、この照度検出器３４により測定された環境照度に基づいて光源２１の点灯およびその出射輝度を制御する光源制御部３５とにより構成しているため、実際の環境照度に応じて前記照明光の輝度を制御し、その環境照度に対して好適な画面輝度を得ることができる。

【００９４】さらに、上記実施例では、液晶表示素子１の背後に配置する照明手段２０を、光源２１と、前記光源２１からの照明光を導いて液晶表示素子１に向けて出射する出射面（導光体２４の複数の段差面２７）と前記液晶表示素子１の前方から入射する外光を前記液晶表示素子１に向けて反射させるための前記出射面とは異なる外光反射面（導光体２４の複数の段面２２ｂ上に形成した反射膜２８）とが形成された導光体２４とを備えた構成としているため、前記出射面（段差面２７）からの照明光の出射率と、前記外光反射面（反射膜２８）による外光の反射率とを、それぞれ独自に選ぶことが可能である。

【００９５】したがって、前記出射面（段差面２７）からの照明光の出射率を高くして前記光源２１からの照明光の利用効率を上げ、その分だけ前記光源２１の発光輝度を低くして、より消費電力を低減するとともに、前記反射面２４での外光の反射率を、液晶表示装置の反射率が所望の値になるように設定することができる。

【００９６】しかも、前記導光体２４は、その前面を階段形状面に形成し、その複数の段面２６上にその全面にわたって反射膜２８を設けたものであるため、この導光体２４は、平坦な反射面を有する通常の反射板と同等の反射特性をもっており、したがって、前方から入射する外光のほとんどを無駄なく反射することができる。

【００９７】なお、前記照明手段２０の前面部材である光学部材３０の複数の入射部３１の屈折面３１ｂは、図３および図４に示したような一定の傾き角をもった直線面に限らず、曲面状の集光屈折面としてもよく、このようにすれば、前記入射部３１の入射面３１ａから取り込まれて前記屈折面３１ｂにより前面方向に向けて屈折される光が、曲面状の集光屈折面である前記屈折面３１ｂの集光作用により所定の方向に集光するため、より強い指向性を持った輝度分布の照明光および反射光を出射することができる。

【００９８】また、この実施例では、前記照明手段２０を構成する導光体２４の背面に反射板２９を設けているが、導光体２４にその入射端面２５から入射した照明光のうちの導光体背面に向かう光のほとんどを、導光体２４の背面と外気（空気）との界面で全反射することができるときは、前記反射板２９を省略してもよい。

【００９９】さらに、上記実施例では、前記導光体２４の階段形状面の複数の段面２６上に反射膜２８を設けているが、その代わりに、前記導光体２４の背面全体に反射膜を設けて導光体背面を外光反射面とし、前方から入射する外光を前記階段形状面の複数の段面２６を透過させて導光板背面の外光反射面により反射するようにしてもよい。

【０１００】また、前記導光体２４は、その複数の端面をそれぞれ光源２１からの照明光を取り込む入射端面としたものでもよく、例えば導光体２４の互いに反対側の２つの端面をそれぞれ入射端面とする場合は、この導光体２４の前面を、両方の入射端面から導光体２４の中間部に向かって段階的に低くなる階段形状面とし、前記両方の入射端面にそれぞれ対向させて光源２１を配置すればよい。

【０１０１】さらに、前記照明手段２０の光源２１は、蛍光ランプ２２を用いるものに限らず、例えば複数のＬＥＤ（発光ダイオード）を整列させたＬＥＤアレイや、ＥＬ（エレクトロルミネセンス）パネル等であってもよい。

【０１０２】ところで、上記液晶表示装置は、外光を利用する反射表示のときの光の透過経路と、照明光を利用する透過表示のときの光の透過経路とが異なっており、反射表示のときは、液晶表示素子１の前方から入射した外光が前記液晶表示素子１を透過してその背後の照明手段２０により反射され、その反射光が前記液晶表示素子１を再び透過して前方に出射するのに対し、透過表示の

ときは、前記照明手段２０からの照明光が前記液晶表示素子１にその背面から入射し、この液晶表示素子１を透過して前方に出射する。

【０１０３】そのため、前記液晶表示素子１は、外光を利用する反射表示のときと、照明光を利用する透過表示のときとで、異なる電圧－透過率特性を示す。

【０１０４】図６は、前記液晶表示素子１の反射表示のときと透過表示のときの電圧－透過率特性を示しており、実線は反射表示のときの電圧－透過率特性、破線は透過表示のときの電圧－透過率特性である。

【０１０５】なお、図６に示した電圧－透過率特性は、無電界状態、つまり液晶分子が基板２，３面に対して最も倒伏した初期配向状態にあるときの透過率が最も高く、電極４，８間に印加される電圧により液晶分子が基板２，３面に対して立ち上がるように配向するのにともなって透過率が透過率が低下するノーマリーホワイモードのＴＮ型液晶表示素子の特性である。

【０１０６】このように、前記液晶表示素子１は、反射表示のときと透過表示のときとで異なる電圧－透過率特性を示すため、電極４，８間に印加される駆動電圧に対する透過率が、前記反射表示のときと前記透過表示のときとで異なり、反射表示のときの表示品位と、照明光を利用する透過表示のときの表示品位とが異なってしまう。

【０１０７】そこで、この液晶表示装置では、前記表示駆動系４０により液晶表示素子１の電極４，８間に選択的に印加する複数の値の駆動電圧を、前記反射表示のときと前記透過表示のときとで個別に制御し、前記反射表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率と、前記透過表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率とを、前記複数の階調ごとにほぼ等しくするようにしている。

【０１０８】この実施例では、前記表示駆動系４０を、前記透過表示のときの前記複数の値の駆動電圧を、前記液晶表示素子１の透過表示のときの電圧－透過率特性に基づいて制御し、前記反射表示のときの前記複数の値の駆動電圧を、前記液晶表示素子１の透過表示のときの電圧－透過率特性と反射表示のときの電圧－透過率特性との差に基づいて制御するように構成している。

【０１０９】前記表示駆動系４０の構成を説明すると、この表示駆動系４０は、図１に示したように、ゲート側駆動回路４１と、データ側駆動回路４２と、前記データ側駆動回路４２に複数の階調の透過率にそれぞれ対応する複数のγ補正電位を供給するγ補正電位供給手段４３とからなっている。

【０１１０】そして、この実施例では、前記γ補正電位供給手段４３から、前記反射表示のときと前記透過表示のときとでそれぞれ異なる値の複数のγ補正電位を前記データ側駆動回路４２に供給するようにしている。

【０１１１】前記γ補正電位供給手段４３は、前記反射表示と前記透過表示の別を判定する反射／透過判定部４４と、この反射／透過判定部４４の判定結果に基づいて、前記反射表示のときの複数のγ補正電位と前記透過表示のときの複数のγ補正電位とのいずれかを前記データ側駆動回路１５に供給するγ補正電位出力部４５とにより構成されている。

【０１１２】前記反射／透過判定部４４は、前記照明手段２０からの照明光の出射に連動して前記反射表示と前記透過表示の別を判定する。

【０１１３】すなわち、この実施例では、前記照明制御手段３３の光源制御部３５を、前記照明手段２０の光源２１を点灯させたときに光源点灯信号を前記反射／透過判定部４４に出力し、前記光源２１を消灯させたときに光源消灯信号を前記反射／透過判定部４４に出力するように構成し、前記反射／透過判定部４４を、前記光源点灯信号が入力されたときに透過表示判定信号を前記γ補正電位出力部４５に出力し、前記光源消灯信号が入力されたときに反射表示判定信号を前記γ補正電位出力部４５に出力するように構成している。

【０１１４】また、前記γ補正電位出力部４５は、その構成を図２に示したように、２通りの複数の基準電位を発生する基準電位発生回路４６と、この基準電位発生回路４６が発生する前記２通りの複数の基準電位のいずれかを前記反射／透過判定部４４の判定結果に基づいて選択し、その選択した複数の電位を前記複数のγ補正電位として前記データ側駆動回路４２に供給する電位選択回路４７とにより構成されている。

【０１１５】図２に示したγ補正電位出力部４５は、階調０～階調１０の１１階調分のγ補正電位を前記データ側駆動回路４２に供給するものであり、前記基準電位発生回路４６は、前記反射表示のときの１１階調分のγ補正電位を得るための１１段階の基準電位（以下、反射表示基準電位という）を発生し、その各基準電位を前記電位選択回路４７に供給する第１の基準電位発生部４６ａと、前記透過表示のときの１１階調分のγ補正電位を得るための１１段階の基準電位（以下、透過表示基準電位という）を発生し、その各基準電位を前記電位選択回路４７に供給する第２の基準電位発生部４６ｂとからなっている。

【０１１６】そして、この実施例では、反射表示のときの階調０～階調１０の透過率と、透過表示のときの階調０～階調１０の透過率とを各階調ごとにほぼ等しくするために、前記第２の基準電位発生部４６ｂが発生する１１段階の透過表示基準電位を、前記液晶表示素子１の透過表示のときの電圧－透過率特性に基づいて設定し、前記第１の基準電位発生部４６ａが発生する１１段階の反射表示基準電位を、前記液晶表示素子１の透過表示のときの電圧－透過率特性と反射表示のときの電圧－透過率特性との差に基づいて設定している。

【０１１７】すなわち、前記液晶表示素子１の反射表示

のときと透過表示のときの電圧－透過率特性が図６に示したような特性である場合、約３０％より低い透過率を得るための駆動電圧と、約６０％より高い透過率を得るための駆動電圧は、透過表示のときよりも反射表示のときの方が低く、約３０％より高く約６０％より低い範囲の透過率を得るための駆動電圧は、透過表示のときよりも反射表示のときの方が僅かに高い。

【０１１８】そのため、この実施例では、前記第１の基準電位発生部４６ａが発生する１１段階の反射表示基準電位のうち、透過率が約３０％より低い各階調のγ補正電位を得るための基準電位と、透過率が約６０％より高い各階調のγ補正電位を得るための基準電位とをそれぞれ、前記第２の基準電位発生部４６ｂが発生する同じ階調のγ補正電位を得るための透過表示基準電位よりも、前記電圧－透過率特性の差に応じた値だけ低く設定し、透過率が約３０％より高く約６０％より低い範囲の各階調のγ補正電位を得るための反射表示基準電位を、前記第２の基準電位発生部２６ｂが発生する同じ階調のγ補正電位を得るための透過表示基準電位よりも、前記電圧－透過率特性の差に応じた値だけ高く設定している。

【０１１９】なお、図６に示したように、約３０％の透過率および約６０％の透過率を得るための駆動電圧は、反射表示のときも透過表示のときもほぼ同じであるため、前記第１の基準電位発生部４６ａが発生する反射表示基準電位のうち、透過率が約３０％の階調のγ補正電位と、透過率が約６０％の階調のγ補正電位とを得るための基準電位は、前記第２の基準電位発生部４６ｂが発生する同じ階調のγ補正電位を得るための透過表示基準電位と同じでよい。

【０１２０】前記電位発生回路４６の第１の基準電位発生部４６ａが発生する１１段階の反射表示基準電位は、前記電位選択回路４７の入力側端子Ａ１～Ｋ１にそれぞれ供給され、第２の基準電位発生部４６ｂが発生する１１段階の透過表示基準電位は、前記電位選択回路４７の入力側端子Ａ２～Ｋ２にそれぞれ供給される。

【０１２１】また、前記電位選択回路４７は、各段階の反射表示基準電位と透過表示基準電位が供給される一対ずつの入力端子Ａ１，Ａ２～Ｋ１，Ｋ２に対してそれぞれ１つずつの出力端子Ａ～Ｋを有しており、前記反射／透過判定部４４からの反射／透過判定信号に基づいて、その信号が反射表示判定信号であるときは、入力側端子Ａ１～Ｋ１にそれぞれ供給された各段階の反射表示基準電位を前記出力端子Ａ～Ｋから出力し、前記反射／透過判定部４４からの反射／透過判定信号が透過表示判定信号であるときは、入力側端子Ａ２～Ｋ２にそれぞれ供給された各段階の透過表示基準電位を前記出力端子Ａ～Ｋから出力する。

【０１２２】この前記電位選択回路４７の各出力端子Ａ～Ｋから出力された各段階の基準電位は、それぞれオペアンプ４８を介して増幅され、Ｖ０～Ｖ１０の１１階調分のγ補正電位として前記データ側駆動回路４２に供給される。

【０１２３】そして、前記データ側駆動回路４２は、上述したように、前記γ補正電位供給手段４３から供給される前記Ｖ０～Ｖ１０の１１階調分のγ補正電位のなかから、外部から供給される画像データに対応するγ補正電位を選択し、その電位のデータ信号を液晶表示素子１の複数のデータラインに供給する。

【０１２４】したがって、上記表示駆動系４０により液晶表示素子１の電極４，８間に選択的に印加される複数の値の駆動電圧は、外光を利用する反射表示のときは、上記反射表示基準電位から得られたγ補正電位に対応する電圧であり、照明光を利用する透過表示のときは、上記透過表示基準電位から得られたγ補正電位に対応する電圧であり、そのため、前記反射表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率と、前記透過表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率とを、前記複数の階調ごとにほぼ等しくすることができる。

【０１２５】すなわち、上記液晶表示装置は、前記表示駆動系４０により前記液晶表示素子１の電極４，８間に選択的に印加する前記複数の値の駆動電圧を、前記反射表示のときと前記透過表示のときとで個別に制御し、前記反射表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率と、前記透過表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率とを、前記複数の階調ごとにほぼ等しくしたであり、この液晶表示装置によれば、外光を利用する反射表示のときも、照明光を利用する透過表示のときも、ほぼ同じ品位の表示を得ることができる。

【０１２６】しかも、上記液晶表示装置においては、前記表示駆動系４０を、前記透過表示のときの複数の値の駆動電圧を、液晶表示素子１の透過表示のときの電圧－透過率特性に基づいて制御し、前記反射表示のときの複数の値の駆動電圧を、前記液晶表示素子１の透過表示のときの電圧－透過率特性と反射表示のときの電圧－透過率特性との差に基づいて制御するように構成しているため、反射表示のときの表示品位を、透過表示のときの表示品位とほぼ等しくし、反射表示のときも透過表示のときも、明表示の輝度が高く、またコントラストの高い表示を得ることができる。

【０１２７】すなわち、前記液晶表示素子１の反射表示のときと透過表示のときの電圧－透過率特性を比較すると、図６に示したように、透過表示のときの電圧－透過率特性の方が、明表示の輝度が高く、またコントラストの高い表示が得られる特性であり、したがって、上記のように、透過表示のときの複数の値の駆動電圧を、前記液晶表示素子１の透過表示のときの電圧－透過率特性に基づいて制御し、反射表示のときの複数の値の駆動電圧を、前記液晶表示素子１の透過表示のときの電圧－透過

率特性と反射表示のときの電圧－透過率特性との差に基づいて制御するようにすれば、反射表示のときも透過表示のときも、明表示の輝度が高く、またコントラストの高い表示を得ることができる。

【０１２８】また、上記液晶表示装置で用いた液晶表示素子１は、アクティブマトリックス液晶表示素子であるが、上記実施例では、前記表示駆動系４０を、前記複数のゲートラインに接続されたゲート側駆動回路４１と、前記複数のデータラインに接続されたデータ側駆動回路４２と、前記データ側駆動回路４２に前記複数の階調の透過率にそれぞれ対応する複数のγ補正電位を供給するγ補正電位供給手段４３とからなり、前記γ補正電位供給手段４３が、前記反射表示のときと前記透過表示のときとでそれぞれ異なる値の複数のγ補正電位を前記データ側駆動回路４２に供給し、前記データ側駆動回路４２が、前記γ補正電位供給手段４３から供給される前記複数のγ補正電位のなかから画像データに対応するγ補正電位を選択して、その電位のデータ信号を前記データラインに供給する構成としているため、前記アクティブマトリックス液晶表示素子１の表示品位を、外光を利用する反射表示のときも、照明光を利用する透過表示のときも、ほぼ同じにすることができる。

【０１２９】そして、上記実施例では、前記γ補正電位供給手段４３を、前記反射表示と前記透過表示の別を判定する反射／透過判定部４４と、この反射／透過判定部４４の判定結果に基づいて、前記反射表示のときの複数のγ補正電位と前記透過表示のときの複数のγ補正電位とのいずれかを前記データ側駆動回路４２に供給するγ補正電位出力部４５とにより構成しているため、反射表示と透過表示の別に応じて、前記データ側駆動回路４２に供給するγ補正電位を自動的に切換えることができる。

【０１３０】さらに、上記実施例では、前記γ補正電位出力部４５を、図２に示したように、２通りの複数の基準電位を発生する基準電位発生回路４６と、この基準電位発生回路４６が発生する前記２通りの複数の基準電位のいずれかを前記反射／透過判定部４４の判定結果に基づいて選択し、その選択した複数の電位を前記複数のγ補正電位として前記データ側駆動回路４２に供給する電位選択回路４７とにより構成しているため、前記データ側駆動回路４２に供給するγ補正電位を、反射表示と透過表示の別に応じて確実に切換えることができる。

【０１３１】また、上記実施例では、前記反射／透過判定部４４を、前記照明手段２０からの照明光の出射に連動して前記反射表示と前記透過表示の別を判定するように構成しているため、反射表示と透過表示の別を信頼性良く判定し、その表示のときのγ補正電位を前記データ側駆動回路４２に供給することができる。

【０１３２】なお、前記液晶表示素子１の表示駆動系４０は、反射表示のときの複数の値の駆動電圧を、液晶表示素子１の反射表示のときの電圧－透過率特性に基づいて制御し、透過表示のときの複数の値の駆動電圧を、前記液晶表示素子１の反射表示のときの電圧－透過率特性と透過表示のときの電圧－透過率特性との差に基づいて制御するように構成してもよく、このようにすることにより、照明光を利用する透過表示のときの表示品位を、外光を利用する反射表示のときの表示品位とほぼ等しくすることができる。

【０１３３】また、上記実施例では、上記γ補正電位出力部４５から出力する反射表示のときのγ補正電位と透過表示のときのγ補正電位とを、ほとんどの階調において互いに異ならせているが、液晶表示素子１の表示品位に大きく影響するのは、主に明表示の輝度であるため、中間階調から暗階調の階調範囲の透過率に対応する反射表示のときのγ補正電位と透過表示のときのγ補正電位は同じにしてもよく、このようにしても、反射表示のときと透過表示のときの表示品位をほぼ同じにすることができる。

【０１３４】さらに、上記実施例では、前記照明手段２０から照明光の出射させたときに透過表示と判定して、γ補正電位を透過表示のときの電位に切換えるようにしているが、環境照度と前記照明手段２０が出射する照明光の輝度との両方を測定し、環境照度に対する照明光の輝度比が所定の値以上になったときに透過表示と判定して、γ補正電位を透過表示のときの電位に切換えるようにしてもよい。

【０１３５】このようにすれば、照明光よりも外光の反射光の出射量が多いとき、つまり、表示に利用される光が主に外光であるときは、反射表示のときのγ補正電位を用いて液晶表示素子１を駆動し、外光の反射光よりも照明光の出射量が多いとき、つまり、表示に利用される光が主に照明光であるときに、透過表示のときのγ補正電位を用いて液晶表示素子１を駆動することができる。

【０１３６】また、上記実施例の液晶表示装置で用いた照明手段２０は、光源２１と、前記光源２１からの照明光を導いて液晶表示素子１に向けて出射する出射面（導光体２４の複数の段差面２７）と前記液晶表示素子１の前方から入射する外光を前記液晶表示素子１に向けて反射させるための前記出射面とは異なる外光反射面（導光体２４の複数の段面２２ｂ上に形成した反射膜２８）とが形成された導光体２４とを備えた構成のものであるが、前記照明手段２０は、照明光を液晶表示素子１に照射する手段と、前記液晶表示素子１の前方から入射する外光を反射してその反射光を前記液晶表示素子１に照射する反射手段とからなるものであれば、例えば、照明光を出射する照明パネルの前面に半透過反射板を配置したものなどでもよい。

【０１３７】

【発明の効果】この発明の液晶表示装置は、外光を利用する反射表示と、照明光を利用する透過表示との両方の

表示を行なう２ウエイ表示型のものであるが、液晶表示素子の電極間に選択的に印加する前記複数の値の駆動電圧を、反射表示のときと透過表示のときとで個別に制御し、前記反射表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率と、前記透過表示のときの複数の値の駆動電圧にそれぞれ対応する複数の階調の透過率とを、前記複数の階調ごとにほぼ等しくしているため、外光を利用する反射表示のときも、照明光を利用する透過表示のときも、ほぼ同じ品位の表示を得ることができる。

【０１３８】この発明の液晶表示装置において、前記表示駆動系は、例えば、前記透過表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の透過表示のときの電圧－透過率特性に基づいて制御し、前記反射表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の透過表示のときの電圧－透過率特性と反射表示のときの電圧－透過率特性との差に基づいて制御するように構成すればよく、このようにすることにより、反射表示のときの表示品位を、透過表示のときの表示品位とほぼ等しくすることができる。

【０１３９】また、前記液晶表示素子の表示駆動系は、前記反射表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の反射表示のときの電圧－透過率特性に基づいて制御し、前記透過表示のときの前記複数の値の駆動電圧を、前記液晶表示素子の反射表示のときの電圧－透過率特性と透過表示のときの電圧－透過率特性との差に基づいて制御するように構成してもよく、このようにすることにより、透過表示のときの表示品位を、反射表示のときの表示品位とほぼ等しくすることができる。

【０１４０】この発明の液晶表示装置において、前記液晶表示素子が、その一方の基板の内面に、複数の画素電極と、これらの画素電極にそれぞれ接続された複数の薄膜トランジスタと、前記複数の薄膜トランジスタにそれぞれ接続された複数のゲートラインおよびデータラインが設けられ、他方の基板の内面に、前記複数の画素電極に対向する対向電極が設けられたアクティブマトリックス液晶表示素子である場合、前記表示駆動系は、前記複数のゲートラインに接続されたゲート側駆動回路と、前記複数のデータラインに接続されたデータ側駆動回路と、前記データ側駆動回路に前記複数の階調の透過率にそれぞれ対応する複数のγ補正電位を供給するγ補正電位供給手段とからなり、前記γ補正電位供給手段が、前記反射表示のときと前記透過表示のときとでそれぞれ異なる値の複数のγ補正電位を前記データ側駆動回路に供給し、前記データ側駆動回路が、前記γ補正電位供給手段から供給される前記複数のγ補正電位のなかから画像データに対応するγ補正電位を選択して、その電位のデータ信号を前記データラインに供給する構成とすればよく、このように前記表示駆動系を構成することにより、前記アクティブマトリックス液晶表示素子の表示品位を、外光を利用する反射表示のときも、照明光を利用する透過表示のときも、ほぼ同じにすることができる。

【０１４１】この場合、前記γ補正電位供給手段は、前記反射表示と前記透過表示の別を判定する反射／透過判定部と、この反射／透過判定部の判定結果に基づいて、前記反射表示のときの複数のγ補正電位と前記透過表示のときの複数のγ補正電位とのいずれかを前記データ側駆動回路に供給するγ補正電位出力部とにより構成するのが望ましく、このようにすることにより、反射表示と透過表示の別に応じて、前記データ側駆動回路に供給するγ補正電位を自動的に切換えることができる。

【０１４２】さらに、前記γ補正電位出力部は、２通りの複数の基準電位を発生する基準電位発生回路と、この基準電位発生回路が発生する前記２通りの複数の基準電位のいずれかを前記反射／透過判定部の判定結果に基づいて選択し、その選択した複数の電位を前記複数のγ補正電位として前記データ側駆動回路に供給する電位選択回路とにより構成するのが好ましく、このようにすることにより、前記データ側駆動回路に供給するγ補正電位を、反射表示と透過表示の別に応じて確実に切換えることができる。

【０１４３】また、前記反射／透過判定部は、前記照明手段からの照明光の出射に連動して前記反射表示と前記透過表示の別を判定するように構成するのが望ましく、このようにすることにより、反射表示と透過表示の別を信頼性良く判定し、その表示のときのγ補正電位を前記データ側駆動回路に供給することができる。

【図面の簡単な説明】

【図１】この発明の一実施例を示す液晶表示装置の基本構成図。

【図２】図１におけるγ補正電位出力部の詳細図。

【図３】前記液晶表示装置の具体的な構成を示す側面図。

【図４】図３の一部分の拡大図。

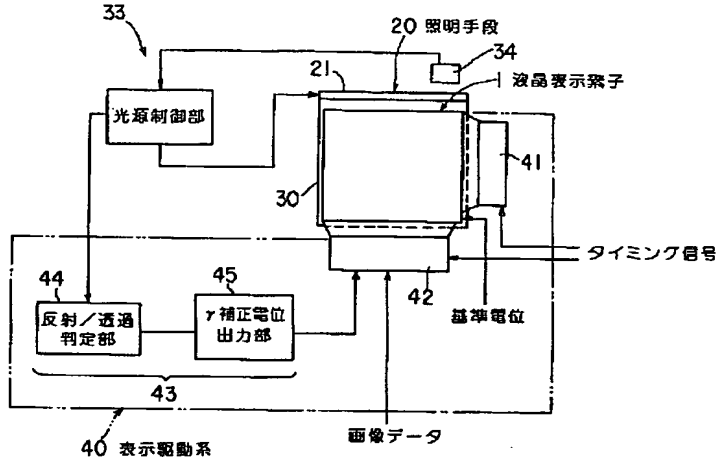
【図５】前記液晶表示装置に用いた液晶表示素子の一部分の断面図。

【図６】前記液晶表示素子の反射表示のときと透過表示のときの電圧－透過率特性を示す図。

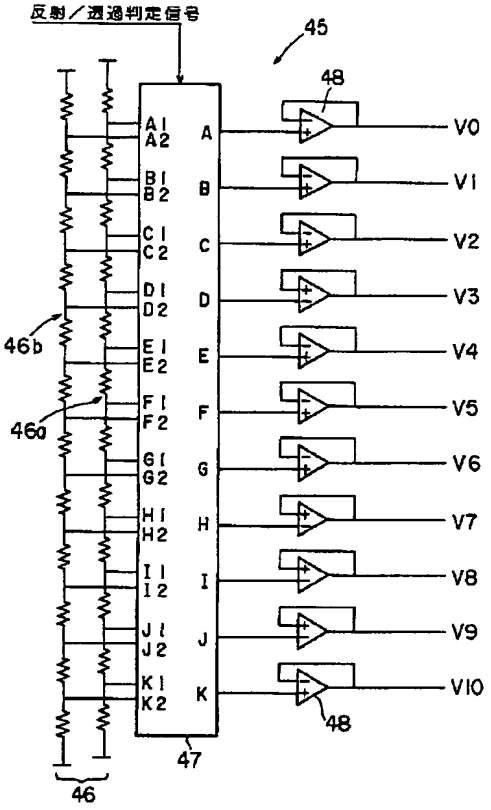
【符号の説明】

１…液晶表示素子
２０…照明手段
４０…表示駆動系
４１…ゲート側駆動回路
４２…データ側駆動回路
４３…γ補正電位供給手段
４４…反射／透過判定部
４５…γ補正電位出力部
４６…基準電位発生回路
４７…電位選択回路

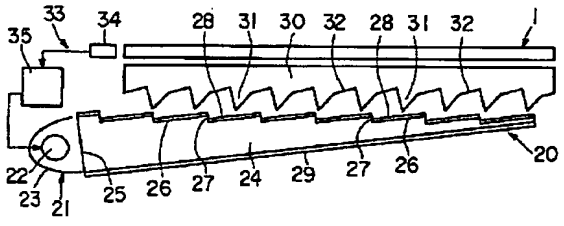
【図１】



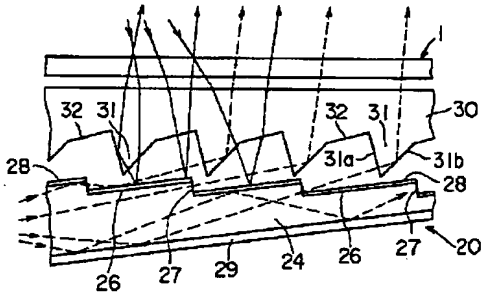
【図２】



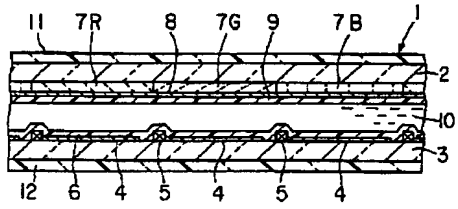
【図３】



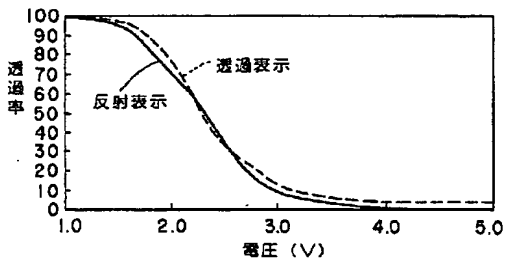
【図４】



【図５】



【図６】



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EA01 FA47 FA54
5C080 AA10 BB05 CC03 DD04 EE28
FF11 JJ02 JJ03 JJ05 JJ06

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the liquid crystal display of the 2-way display mold which displays both a reflective display and a transparency display.
[0002]
[Description of the Prior Art] The liquid crystal display of a 2-way display mold arranges a lighting means to turn to said liquid crystal display component the outdoor daylight which carries out incidence from the front of said liquid crystal display component, and to reflect behind [where the electrode was prepared in the inner surface of the substrate of the couple which counters on both sides of a liquid crystal layer, respectively] a liquid crystal display component while turning and carrying out outgoing radiation of the illumination light to said liquid crystal display component, and is constituted. In addition, generally as said lighting means, what has arranged the transflective reflecting plate is used for the front face of the lighting panel which carries out outgoing radiation of the illumination light.
[0003] The reflective display which said 2-way liquid crystal display reflects the outdoor daylight which carries out incidence from the front of said liquid crystal display component with said lighting means, and the outgoing radiation of the reflected light is made to carry out ahead [of said liquid crystal display component], and is displayed, It is what displays both transparency displays which carry out outgoing radiation of the illumination light from said lighting means, and the outgoing radiation of the light is made to carry out ahead [of said liquid crystal display component], and are displayed. Under the environment where the outdoor daylight of sufficient brightness is obtained, the reflective display which uses outdoor daylight, without carrying out outgoing radiation of the illumination light from said lighting means is performed, and the transparency display which is made to carry out outgoing radiation of the illumination light from said lighting means, and uses the illumination light is performed under the environment where the outdoor daylight of sufficient brightness is not obtained.
[0004] If the transparency display using said illumination light is performed when the illuminance of the operating environment of a liquid crystal display is below a predetermined illuminance (i.e., when screen intensity sufficient by just the reflective display using outdoor daylight is not obtained), and outgoing radiation of the illumination light is carried out from said lighting means to the bottom of the environment of such an illuminance, the lack of brightness of the screen by the reflective display using outdoor daylight will be compensated according to concomitant use of the transparency display using the illumination light. Moreover, under the dark environment where outdoor daylight is not obtained, it becomes only the transparency display using the illumination light.
[0005]
[Problem(s) to be Solved by the Invention] However, the conventional 2-way liquid crystal display has the problem that the display grace at the time of the reflective display using outdoor daylight differs from the display grace at the time of the transparency display using the illumination light.
[0006] This is what is depended on the difference between the transparency path of the light at the time of the reflective display using outdoor daylight, and the transparency path of the light at the time of the

transparency display using the illumination light. At the time of a reflective display The outdoor daylight which carried out incidence from the front of a liquid crystal display component penetrates said liquid crystal display component, and is reflected by the lighting means in back. As opposed to the reflected light penetrating said liquid crystal display component again, and carrying out outgoing radiation ahead at the time of a transparency display In order that incidence is carried out to said liquid crystal display component from that tooth back, and the illumination light from said lighting means may penetrate this liquid crystal display component and may carry out outgoing radiation ahead, said liquid crystal display component is with the time of the reflective display using outdoor daylight, and the transparency display using the illumination light, and shows a different electrical-potential-difference-permeability property.

[0007] On the other hand, display actuation of said liquid crystal display component is carried out by impressing selectively the driver voltage of two or more values beforehand set as inter-electrode [which was prepared in the inner surface of the substrate of the couple which counters on both sides of a liquid crystal layer, respectively].

[0008] However, it is with the time of the reflective display for which a liquid crystal display component uses outdoor daylight as mentioned above, and the transparency display using the illumination light, and in order to show a different electrical-potential-difference-permeability property, the permeability to the driver voltage impressed to inter-electrode [said] will differ in the time of said reflective display and said transparency display, and the display grace at the time of a reflective display and the display grace at the time of the transparency display using the illumination light will differ.

[0009] This invention aims at offering the liquid crystal display of the 2-way display mold which can obtain the display of the almost same grace also at the time of the reflective display using outdoor daylight, and the transparency display using the illumination light.

[0010]

[Means for Solving the Problem] The liquid crystal display component with which the electrode was prepared in the inner surface of the substrate of a couple with which the liquid crystal display of this invention counters on both sides of a liquid crystal layer, respectively, A lighting means to turn to said liquid crystal display component the outdoor daylight which carries out incidence, and to reflect from the front of said liquid crystal display component while being arranged behind said liquid crystal display component and turning and carrying out outgoing radiation of the illumination light to said liquid crystal display component, It has the display drive system which impresses the driver voltage of two or more values to inter-electrode [of said liquid crystal display component] selectively. The reflective display which reflect the outdoor daylight which carries out incidence from the front of said liquid crystal display component with said lighting means, and the outgoing radiation of the reflected light is made to carry out ahead [of said liquid crystal display component], and is displayed, While displaying both transparency displays which carry out outgoing radiation of the illumination light from said lighting means, and the outgoing radiation of the light is made to carry out ahead [of said liquid crystal display component], and are displayed The driver voltage of two or more of said values selectively impressed to inter-electrode [of said liquid crystal display component] by said display drive system The permeability of two or more gradation which controls by the time of said reflective display and said transparency display according to an individual, and corresponds to the driver voltage of two or more values at the time of said reflective display, respectively, It is characterized by making almost equal the permeability of two or more gradation which corresponds to the driver voltage of two or more values at the time of said transparency display, respectively for said two or more gradation of every.

[0011] According to the liquid crystal display of this invention, the display of the grace almost same also at the time of the reflective display using outdoor daylight and the transparency display using the illumination light can be obtained.

[0012]

[Embodiment of the Invention] The liquid crystal display of this invention the driver voltage of two or more of said values selectively impressed to inter-electrode [of a liquid crystal display component] as mentioned above The permeability of two or more gradation which controls by the time of a reflective

display and a transparency display according to an individual, and corresponds to the driver voltage of two or more values at the time of said reflective display, respectively, The permeability of two or more gradation which corresponds to the driver voltage of two or more values at the time of said transparency display, respectively by making it almost equal for said two or more gradation of every It enables it to obtain the display of the grace almost same also at the time of the reflective display using outdoor daylight, and the transparency display using the illumination light.

[0013] In the liquid crystal display of this invention said display drive system For example, the driver voltage of two or more of said values at the time of said transparency display is controlled based on the electrical-potential-difference-permeability property at the time of the transparency display of said liquid crystal display component. By doing in this way that what is necessary is just to constitute so that the driver voltage of two or more of said values at the time of said reflective display may be controlled based on the difference of the electrical-potential-difference-permeability property at the time of the transparency display of said liquid crystal display component, and the electrical-potential-difference-permeability property at the time of a reflective display Display grace at the time of a reflective display can be made almost equal to the display grace at the time of a transparency display.

[0014] The display drive system of said liquid crystal display component moreover, the driver voltage of two or more of said values at the time of said reflective display It controls based on the electrical-potential-difference-permeability property at the time of the reflective display of said liquid crystal display component. By constituting so that the driver voltage of two or more of said values at the time of said transparency display may be controlled based on the difference of the electrical-potential-difference-permeability property at the time of the reflective display of said liquid crystal display component, and the electrical-potential-difference-permeability property at the time of a transparency display, and doing in this way Display grace at the time of a transparency display can be made almost equal to the display grace at the time of a reflective display.

[0015] In the liquid crystal display of this invention said liquid crystal display component to the inner surface of the substrate of one of these Two or more pixel electrodes, Two or more thin film transistors connected to these pixel electrodes, respectively, Two or more gate lines and data lines which were connected to said two or more thin film transistors, respectively are prepared. When it is the active-matrix liquid crystal display component with which the counterelectrode which counters said two or more pixel electrodes was prepared in the inner surface of the substrate of another side, said display drive system The gate side actuation circuit connected to said two or more gate lines, and the data side actuation circuit connected to said two or more data lines, It consists of a gamma amendment potential supply means to supply two or more gamma amendment potentials which are equivalent to the permeability of two or more of said gradation, respectively to said data side actuation circuit. The aforementioned gamma amendment potential supply means supplies two or more gamma amendment potentials of a value which is different in the time of said reflective display and said transparency display, respectively to said data side actuation circuit. Said data side actuation circuit chooses gamma amendment potential corresponding to image data from said two or more gamma amendment potentials supplied from the aforementioned gamma amendment potential supply means. The configuration which supplies the data signal of the potential to said data line, then by being good and constituting said display drive system in this way It can be made almost the same also at the time of the reflective display which uses outdoor daylight for the display grace of said active-matrix liquid crystal display component, and the transparency display using the illumination light.

[0016] In this case, echo/transparency judging section in which the aforementioned gamma amendment potential supply means judges the exception of said transparency display to be said reflective display, When it is desirable for gamma amendment potential output section which supplies either of two or more gamma amendment potentials at the time of said reflective display and two or more gamma amendment potentials at the time of said transparency display to said data side actuation circuit to constitute based on the judgment result of this echo/transparency judging section and it does in this way According to the exception of the transparency display with a reflective display, gamma amendment potential supplied to said data side actuation circuit can be switched automatically.

h g cg b eb cg e e

[0017] Furthermore, the reference potential generating circuit where the aforementioned gamma amendment potential output section generates two kinds of two or more reference potentials, Either of said two kinds of two or more reference potentials which this reference potential generating circuit generates is chosen based on the judgment result of said echo/transparency judging section. When it is desirable that the potential selection circuitry supplied to said data side actuation circuit as said two or more gamma amendment potentials constitutes and it carries out two or more of the selected potentials in this way gamma amendment potential supplied to said data side actuation circuit can be certainly switched according to the exception of the transparency display with a reflective display.
[0018] Moreover, as for said echo/transparency judging section, it is desirable to constitute so that the outgoing radiation of the illumination light from said lighting means may be interlocked with and the exception of said transparency display may be judged to be said reflective display, by doing in this way, the exception of the transparency display with a reflective display can be judged with sufficient dependability, and gamma amendment potential at the time of the display can be supplied to said data side actuation circuit.
[0019]
[Example] They are some sectional views of the liquid crystal display component which drawing 1 - drawing 6 show one example of this invention, used for some enlarged drawings of drawing 3 the detail drawing of gamma amendment potential output section [in / drawing 1 , and / in drawing 2 / drawing 1], the side elevation in which drawing 3 shows the concrete configuration of a liquid crystal display, and drawing 4 , and used drawing 5 for the liquid crystal display of this example. [the basic block diagram of a liquid crystal display]
[0020] As shown in drawing 1 and drawing 3 , the liquid crystal display of this example has been arranged behind the liquid crystal display component 1 and this liquid crystal display component 1, and is equipped with a lighting means 20 to turn to said liquid crystal display component 1 the outdoor daylight which carries out incidence, and to reflect from the front of said liquid crystal display component 1 while turning and carrying out outgoing radiation of the illumination light to said liquid crystal display component 1, and the display drive system 40 of said liquid crystal display component 1.
[0021] If said liquid crystal display component 1 is explained, first, the liquid crystal display component 1 used in this example As it is the active-matrix liquid crystal display component which displays multicolor color pictures, such as a full color image, and is shown in drawing 5 To the inner surface of an one substrate 3 of the transparence substrates 2 and 3 of the couple by the side of the front face which counters on both sides of the liquid crystal layer 10, and a tooth back, for example, a tooth-back side substrate Two or more transparent pixel electrodes 4 arranged in the shape of a matrix in a line writing direction and the direction of a train, Two or more thin film transistors (it is hereafter described as TFT) 5 connected to these pixel electrodes 4, respectively, and two or more gate lines and data lines (neither is illustrated) of said plurality which were connected TFT5, respectively are prepared.
[0022] In addition, although drawing 5 simplifies and shows said TFT5 This TFT5 covers the gate electrode formed on the substrate 3, and this gate electrode. The transparent gate dielectric film of a substrate 3 mostly formed in the whole surface, It consists of i-type semiconductor film which was made to counter said gate electrode and was prepared on this gate dielectric film, and the source electrode and drain electrode which were formed through the n-type-semiconductor film on the both-sides section of this i-type semiconductor film.
[0023] Moreover, on said substrate 3, said gate line which is not illustrated is made to meet, respectively, and is wired at the 1 side of each pixel electrode line, and said gate electrode of TFT5 is formed in said gate line at one. In addition, this gate line is also covered by said gate dielectric film except for that terminal area.
[0024] On the other hand, said data line which is not illustrated is made to meet, respectively, and is wired on said gate dielectric film, at the 1 side of each pixel electrode train, said drain electrode of TFT5 is connected to said data line, and the source electrode is connected to said pixel electrode 4.
[0025] Moreover, said two or more pixel electrodes 4 are made to correspond, respectively, the light filters 7R, 7G, and 7B of three colors of the coloring film of two or more colors, for example, red, green,

and blue arrange to the inner surface of the front-face side substrate 2 by turns, and are prepared in it, and the transparent counterelectrode 8 of the shape of one-sheet film which counters said two or more pixel electrodes 4 of all is formed on it.
[0026] This liquid crystal display component 1 is the thing of TN (Twisted Nematic) mold. In addition, the liquid crystal molecule of said liquid crystal layer 10 The direction [/ near these substrates 2 and 3] of orientation is regulated by the inner surface of the substrates 2 and 3 of said couple with the orientation film 9 and 6 prepared, respectively. Twist orientation is carried out on the predetermined twist square (for example, about 90 degrees) between both the substrates 2 and 3, and in the outside surface of the substrates 2 and 3 of said couple, polarizing plates 11 and 12 turn the transparency shaft in the predetermined direction, and are arranged, respectively.
[0027] By supplying a data signal to said two or more data lines, the display drive system 40 of said liquid crystal display component 1 impresses the driver voltage of two or more values selectively between said two or more pixel electrodes 4 and counterelectrodes 8, respectively, and carries out display actuation of said liquid crystal display component 1 while it connects the counterelectrode 8 of said liquid crystal display component 1 to a reference potential and supplies a gate signal to said two or more gate lines.
[0028] Said this display drive system 40 consists of the gate side actuation circuit 41 connected to two or more gate lines of said liquid crystal display component 1, a data side actuation circuit 42 connected to two or more data lines of said liquid crystal display component 1, and a gamma amendment potential supply means 43 to supply two or more gamma amendment potentials which are equivalent to the permeability of two or more gradation, respectively to said data side actuation circuit 42, as shown in drawing 1 .
[0029] Said gate side actuation circuit 41 supplies the wave-like gate signal which the selection period which becomes the potential which makes said TFT5 turn on was synchronized with said timing signal, and shifted it one by one to said two or more gate lines.
[0030] Moreover, said data side actuation circuit 42 chooses gamma amendment potential corresponding to the image data supplied from the outside from said two or more gamma amendment potentials supplied from the aforementioned gamma amendment potential supply means 43, synchronizes the data signal of the potential with said timing signal, and is supplied to said two or more data lines.
[0031] And the data signal supplied to said two or more data lines is supplied to the pixel electrode 4 of each train through TFT5 by which sequential ON is carried out for every line with said gate signal, and the driver voltage according to the potential of said data signal, i.e., gamma amendment potential corresponding to said image data, is impressed between the counterelectrodes 8 connected at these pixel electrodes 4 and said reference potentials.
[0032] When the lighting means 20 arranged behind said liquid crystal display component 1 is explained, next, this lighting means 20 The transparent material 24 which reflects ahead the outdoor daylight which carries out incidence from the front of said liquid crystal display component 1 while incorporating the illumination light from the light source 21 which emits the illumination light, and this light source 21 from an end face and carrying out outgoing radiation ahead, as shown in drawing 3 and drawing 4 , It is constituted by the optical member 30 arranged at the front-face side of this transparent material 24.
[0033] Said transparent material 24 is a transparence plate which consists of acrylic resin etc., and the end side is the incidence end face 25 which incorporates the light from said light source 21. Moreover, it is formed in the stairway shaped surface of the minute pitch which consists of two or more parallel **** 26 and two or more level difference sides 27 which connect these **** 26 where the front face of this transparent material 24 becomes low gradually toward said incidence end-face 25 side to an other end side (spacing on the tooth back of a transparent material is narrowed), and which were formed like, and the specular reflection plate 29 of each other is formed in the tooth back.
[0034] Two or more level difference sides 27 of said stairway shaped surface are fields almost parallel to said incidence end face 25, and said **** 26 between these level difference sides 27 is an oblong flat side which meets crosswise [of a transparent material 24] (the die-length direction of the incidence end

face 25).
[0035] And on said two or more **** 26 of said transparent material 24, the specular reflection film 28 which consists of vacuum evaporationo film of high reflection factor metals, such as aluminum, over the whole surface is formed, respectively, and the outdoor daylight reflector which reflects ahead the outdoor daylight which carries out incidence from the front of said liquid crystal display component 1 with these reflective film 28 is formed.
[0036] Moreover, said two or more level difference sides 26 of said transparent material 24 are made into the light transmission side which does not form the reflective film, and are the outgoing radiation sides of the illumination light in which these level difference sides 26 carried out incidence from said incidence end face 25, respectively.
[0037] Said light source 21 consists of a straight pipe-like fluorescent lamp 22 of the die length covering the overall length of the incidence end face 25 of said transparent material 24, and a reflector 23 which turns the synchrotron orbital radiation from this fluorescent lamp 22 to the incidence end face 25 of said transparent material 24, and is reflected, and this light source 21 makes the side of said transparent material 24 counter that incidence end face 25, and is arranged.
[0038] On the other hand, while said optical member 30 carries out outgoing radiation of the light which carries out incidence from that front face to a tooth back, it has the property which incorporates the illumination light which carries out outgoing radiation of the light which it is reflected by the reflective film 28 on two or more **** 26 of said transparent material 24, and carries out incidence from the tooth back of this optical member 30 to a front face, and carries out outgoing radiation from two or more level difference sides (outgoing radiation side) 27 of said transparent material 24 from a tooth back, and carries out outgoing radiation ahead.
[0039] This optical member 30 is a transparence plate which consists of acrylic resin which has the almost same breadth as said transparent material 24, that front face is made into a flat side, and two or more incidence sections 31 for incorporating the light which carries out outgoing radiation from two or more level difference sides 27 of the stairway shaped surface of said transparent material 24 are formed in the tooth back at one.
[0040] These incidence sections 31 consist of an oblong projection which has the cross-section configuration of the shape of a triangle formed covering the breadth overall length of the optical member 30. Said optical member 30 While making parallel mostly the die-length direction of two or more incidence sections 31 of the tooth back with the die-length direction of two or more level difference sides 27 of said transparent material 24, the crowning of two or more of said incidence sections 31 is made to approach or contact the reflective film 28 on two or more **** 26 of said transparent material 24, and it is arranged.
[0041] And while counters the level difference side 27 of said transparent material 24 among the both-sides sides of two or more of said incidence sections 31, the side face has become plane-of-incidence 31a which incorporates the light which carries out outgoing radiation from said level difference side 27, and the side face of another side has become refracting interface 31b which the light incorporated from said plane-of-incidence 31a is turned [b] in the direction of a front face of the optical member 30, and makes it refracted.
[0042] Said plane-of-incidence 31a is the level difference side 27 of said transparent material 24, and a field with the inclination almost near parallel or it, and said refracting interface 31b is an inclined plane in which the include angle with the normal of the front face of the optical member 30 to make has whenever [bigger tilt-angle / than the include angle of said plane-of-incidence 31a and said normal to make].
[0043] In addition, the desirable configuration of said incidence section 31 is a configuration where inclined 5 to 15 degrees in the direction in which plane-of-incidence 31a faces the level difference side 27 of said transparent material 24 to said normal, and refracting interface 31b inclined 20 to 50 degrees in the opposite direction to said normal.
[0044] Moreover, between each, said two or more incidence sections 31 consist spacing, and are prepared in the fixed pitch, and the tooth-back field between the incidence sections 31 which said optical

member 30 adjoins serves as the close outgoing radiation side 32 which counters the reflective film 28 on two or more **** 26 of said transparent material 24.
[0045] This close outgoing radiation side 32 is a field for making the light which carries out incidence from the front of the liquid crystal display component 1, and it is reflected by the reflective film 28 on two or more **** 26 of said transparent material 24, and carries out outgoing radiation ahead penetrate, and has **** 26 and the inclination almost near parallel or it of said transparent material 24.
[0046] Furthermore, two or more incidence sections 31 of said optical member 30 are formed in the pitch smaller than the pitch of the level difference side 27 of said transparent material 24, therefore, as for two or more level difference sides 27 of said transparent material 24, the each has surely countered at least one incidence section 31 of 30 of said optical member.
[0047] In addition, although the stairway shaped surface of a transparent material 24 and the close outgoing radiation side 32 of two or more incidence sections 31 of the optical member 30 and the meantime were expanded greatly and drawing 3 and drawing 4 showed them for convenience [whether the pitch of the incidence section 31 of said optical member 30 is almost the same as the pitch of the pixel field (field where two or more pixel electrodes 4 and counterelectrodes 8 counter mutually) of the liquid crystal display component 1, and] Or it is set up smaller than it and the pitch of the level difference side 27 of said transparent material 24 is greatly set up a little rather than the pitch of the incidence section 31 of said optical member 30 according to the pitch of the incidence section 31 of this optical member 30.
[0048] In the liquid crystal display of this example, and the lighting means 20 which consists of the above-mentioned light source 21, a transparent material 24, and an optical member 30 While setting mostly the axis of abscissa of the screen of the liquid crystal display component 1 as the die-length direction of two or more incidence sections 31 of said optical member 30, and the die-length direction of two or more level difference sides 27 of a transparent material 24 at parallel, the arrangement side of said light source 21 was turned in the main incorporation directions of outdoor daylight, and is arranged behind said liquid crystal display component 1.
[0049] That is, generally, the liquid crystal display of a reflective mold is used for the sense of a screen, choosing so that outdoor daylight may mainly be incorporated from the direction which inclined to the upper limb side of said screen to the normal of a screen.
[0050] Therefore, in this example, the above-mentioned lighting means 20 is arranged towards the upper limb, i.e., upper limb of liquid crystal display component 1, side (it sets to drawing 3 and is left-hand side) of the screen which are the main incorporation directions of outdoor daylight about the arrangement side of the light source 21.
[0051] Moreover, the above-mentioned lighting means 20 is equipped with the lighting control means 33 which controls the outgoing radiation of the illumination light from this lighting means 20, and it controls the brightness of that illumination light according to the illuminance of said environment while it carries out outgoing radiation of the illumination light automatically, when the illuminance of the operating environment of a liquid crystal display becomes below a predetermined value.
[0052] Said lighting control means 33 consists of an illuminance detector 34 which measures an environmental illuminance as shown in drawing 1 and drawing 3 , and a light source control section 35, and said illuminance detector 34 makes a light-receiving side parallel mostly with the front face of said liquid crystal display component 1, and is arranged near this liquid crystal display component 1 so that the same environmental illuminance as the illuminance of the outdoor daylight which carries out incidence to the liquid crystal display component 1 from that front may be measured.
[0053] Said light source control section 35 is based on the environmental illuminance measured by said illuminance detector 34. Control burning and its outgoing radiation brightness of said light source 21, and when said environmental illuminance is below a predetermined illuminance (illuminance from which screen intensity sufficient by just the reflective display using outdoor daylight is not obtained) set up beforehand While making said light source 21 turn on, it controls to become the brightness range where the outgoing radiation brightness of this light source 21 was beforehand set to the screen intensity of said liquid crystal display component 1 according to the environmental illuminance.

[0054] The reflective display which this liquid crystal display reflects the outdoor daylight which carries out incidence from the front of the liquid crystal display component 1 with said lighting means 20, and the outgoing radiation of that reflected light is made to carry out ahead [of said liquid crystal display component 1], and is displayed, It is the thing of the 2-way display mold which displays both transparency displays which carry out outgoing radiation of the illumination light from said lighting means 20, and the outgoing radiation of the light is made to carry out ahead [of said liquid crystal display component 1], and are displayed. Under the environment where the outdoor daylight of sufficient brightness is obtained, the reflective display which uses outdoor daylight, without carrying out outgoing radiation of the illumination light from said lighting means 20 is performed, and the transparency display which is made to carry out outgoing radiation of the illumination light from said lighting means 20, and uses the illumination light is performed under the environment where the outdoor daylight of sufficient brightness is not obtained.
[0055] First, if the outgoing radiation path of the outdoor daylight at the time of said reflective display is explained, outdoor daylight carries out incidence of that path to the liquid crystal display component 1 from that front at drawing 4 , as the continuous line showed, and it penetrates this liquid crystal display component 1, and it will be reflected by said lighting means 20, and it will penetrate said liquid crystal display component 1 again, and it will carry out outgoing radiation ahead.
[0056] That is, the outdoor daylight which carried out [outdoor daylight] incidence to the liquid crystal display component 1 from that front, penetrated this liquid crystal display component 1, and carried out outgoing radiation to that tooth back carries out incidence to the optical member 30 which is a front member of said lighting means 20 from that front face, and this optical member 30 is penetrated at the time of a reflective display, carries out outgoing radiation to that tooth back, and it is reflected by the reflective film 28 on two or more **** 26 of said transparent material 24.
[0057] In addition, although incidence of the outdoor daylight which penetrated the liquid crystal display component 1 is mainly carried out to said optical member 30 from the arrangement side of said light source 21 in this liquid crystal display since said lighting means 20 is arranged towards the upper limb side of the screen which are the main incorporation directions of the outdoor daylight of a liquid crystal display about the arrangement side of the light source 21 as mentioned above, that incident angle is various.
[0058] Therefore, the outdoor daylight which carried out incidence to said optical member 30 from the front face Although it progresses in the various directions toward that tooth back, the inside of this optical member 30 Refracting interface 31b with the large tilt angle of two or more incidence sections 31 on the tooth back of an optical member among that incident light, The light which goes to the close outgoing radiation side 32 between the adjoining incidence sections 31 penetrates the interface of these fields 31b and 32 and open air (air space between a transparent material 24 and the optical member 30), it carries out outgoing radiation to a tooth back, and it is reflected by the reflective film 28 on **** 26 of said transparent material 24.
[0059] Moreover, although the light which goes to plane-of-incidence 31a with the tilt angle of said incidence section 31 small among said incident light does not illustrate that path, total reflection of it is carried out by the interface of this plane-of-incidence 31a and open air, and it changes the sense, it carries out outgoing radiation to a tooth back from said refracting interface 31b or the close outgoing radiation 32, and it is reflected by the reflective film 28 on **** 26 of said transparent material 24.
[0060] The reflected light reflected by the reflective film 28 on two or more **** 26 of said transparent material 24 is incorporated by said optical member 30 from that tooth back, penetrates this optical member 30, and it carries out outgoing radiation from that front face.
[0061] At this time, since the include angle of **** 26 of said transparent material 24 and plane-of-incidence 31a of two or more incidence sections 31 of said optical member 30 to make is large (close to a right angle), as for the reflected light reflected by the reflective film 28 on **** 26 of a transparent material 24, that most is incorporated from refracting interface 31b of two or more incidence sections 31 of the optical member 30, and said close outgoing radiation side 32.
[0062] And the light which goes to the front face of the direct optical member 30 of the light

incorporated from refracting interface 31b of said incidence section 31 and the light incorporated from said close outgoing radiation side 32 The light which goes to plane-of-incidence 31a of an opposite hand among the light which penetrated the optical member 30 with the sense, carried out outgoing radiation from the front face, and was incorporated from refracting interface 31b of said incidence section 31 Total reflection is carried out by the interface of this plane-of-incidence 31a and open air, the sense is changed, the sense is changed in the direction near the direction of the light which goes to the front face of the direct optical member 30 from said refracting interface 31b and the close outgoing radiation side 32, and outgoing radiation is carried out from the front face of the optical member 30.

[0063] Therefore, the reflected light of the outdoor daylight which carries out outgoing radiation to the front face (front face of the optical member 30) of said lighting means 20 is the light of the high brightness by which the outdoor daylight which carried out incidence by various incident angles was condensed in the direction of a transverse plane (the direction of [near the normal of the front face of the optical member 30]), therefore the reflected light of this outdoor daylight is the light of luminance distribution with the high brightness of the light which carries out outgoing radiation in the direction of a transverse plane.

[0064] That is, the reflected light of the outdoor daylight which carries out outgoing radiation to the front face of said optical member 30 is the light of luminance distribution with the high brightness of the light which carries out outgoing radiation in the direction of a transverse plane which the light which carried out [light] incidence to the light of the luminance distribution which carried out incidence from said incidence section 31, and was condensed in the direction of a transverse plane from the close outgoing radiation side 32 between said incidence sections 31, and was penetrated in the direction of a front face superimposed.

[0065] And incidence of said reflected light which carried out outgoing radiation from the front face of said lighting means 20 is carried out to said liquid crystal display component 1 from that tooth back, and it penetrates this liquid crystal display component 1 again, and it carries out outgoing radiation ahead from that front face.

[0066] In addition, since said liquid crystal display component 1 is equipped with the light filters 7R, 7G, and 7B of the red corresponding to two or more pixel electrodes 4, green, and blue, respectively, The light which carries out outgoing radiation from two or more pixel fields where two or more of said pixel electrodes 4 and counterelectrodes 8 counter mutually Are red, green, and a blue coloring light and the outgoing radiation reinforcement of such coloring light is controlled by orientation change of the electrode 4 of the pixel field and the liquid crystal molecule according to the driver voltage impressed among eight. The multicolor color picture of full color ** is displayed by the color mixture of the red of various gradation which carries out outgoing radiation from said two or more pixel fields, respectively, green, and a blue coloring light.

[0067] Next, if the outgoing radiation path of the illumination light at the time of a transparency display is explained, the light source 21 of said lighting means 20 will be turned on when performing said transparency display.

[0068] The illumination light from this light source 21 is incorporated by said transparent material 24 from that incidence end face 25, and the inside of a transparent material 24 is led to it in that die-length direction, and it carries out outgoing radiation to drawing 4 like the path shown with the broken line from any of two or more level difference sides 27 of the front face of a transparent material.

[0069] In addition, although the illumination light incorporated from the incidence end face 25 progresses the inside of a transparent material 24 to said transparent material 24 toward various directions, outgoing radiation of the light which goes to said two or more level difference sides 27 of them directly is carried out from the level difference side 27.

[0070] Moreover, it is reflected by the reflective film 29 prepared in the rear face and transparent material tooth back of the reflective film 28 on said **** 26, and light other than the light which goes to said level difference side 27 directly, i.e., the light which progresses toward **** 26 between said two or more level difference sides 27, and the light which progresses toward the tooth back of a transparent material 24 change the sense, it carries out incidence to either of said two or more level difference sides

27, and it carries out outgoing radiation from the level difference side 27.
[0071] Therefore, most illumination light incorporated by said transparent material 24 from the incidence end face 25 carries out outgoing radiation from said two or more level difference sides 27 without futility.
[0072] Incidence of the illumination light which carried out outgoing radiation from two or more level difference sides 27 of said transparent material 24 is carried out to two or more incidence sections 31 of the tooth back of the optical member 30 arranged at the front-face side of said transparent material 24 from plane-of-incidence 31a of the one side face.
[0073] Since that each has surely countered at least one incidence section 31 of 30 of said optical member at this time, most illumination light which carried out outgoing radiation from two or more level difference sides 27 of said transparent material 24 carries out incidence of two or more level difference sides 27 of said transparent material 24 to one incidence section 31 of the optical members 30 without futility.
[0074] In addition, although the light which carries out outgoing radiation toward next **** 26 is also in the illumination light which carries out outgoing radiation from two or more level difference sides 27 of said transparent material 24 as shown in drawing 4 , it is reflected by the reflective film 28 on said next **** 26, and incidence of the light is carried out to the incidence section 31 of said optical member 30.
[0075] Total reflection of the illumination light which carried out incidence to two or more incidence sections 31 of said optical member 30 from plane-of-incidence 31a of that one side face is carried out by the interface of refracting interface 31b of an opposite hand, and the open air (air space between a transparent material 24 and the optical member 30), and it changes the sense in the direction of a front face of the optical member 30, penetrates this optical member 30, and it carries out outgoing radiation to said plane-of-incidence 31a from that front face.
[0076] The illumination light which carries out outgoing radiation to the front face of this optical member 30 is the light of luminance distribution with the high brightness of the predetermined direction which carried out incidence to said two or more incidence sections 31 from plane-of-incidence 31a of that one side face, was refracted by refracting interface 31b of an opposite hand, and condensed in the predetermined direction.
[0077] The illumination light which has set up the tilt angle of refracting interface 31b of said incidence section 31 so that the sense of the light refracted by this refracting interface 31b may become in the direction of a transverse plane, therefore carries out outgoing radiation to the front face of the optical member 30 in this example is the light of the distribution whose brightness of the direction of a transverse plane had high directivity. The direction of outgoing radiation of the illumination light which carries out outgoing radiation to the front face of this optical member 30 is a direction according to the tilt angle of refracting interface 31b of said incidence section 31, and when the range of the tilt angle of said refracting interface 31b is 20 - 50 degrees to the normal of the front face of the optical member 30, it becomes more close to the direction of a transverse plane.
[0078] And incidence of the light which carried out outgoing radiation ahead [of said optical member 30], i.e., the illumination light which carried out outgoing radiation from the lighting means 20, is carried out to the liquid crystal display component 1 from that tooth back, and it penetrates this liquid crystal display component 1, and it carries out outgoing radiation ahead from that front face.
[0079] The light which carries out outgoing radiation also of the time of this transparency display from two or more pixel fields of said liquid crystal display component 1 Are red, green, and a blue coloring light and the outgoing radiation reinforcement of such coloring light is controlled by orientation change of the electrode 4 of the pixel field and the liquid crystal molecule according to the driver voltage impressed among eight. The multicolor color picture of full color ** is displayed by the color mixture of the red of various gradation which carries out outgoing radiation from said two or more pixel fields, respectively, green, and a blue coloring light.
[0080] If the transparency display using said illumination light is performed when an environmental illuminance is below a predetermined illuminance (i.e., when screen intensity sufficient by just the reflective display using outdoor daylight is not obtained), and outgoing radiation of the illumination

light is carried out from said lighting means 20 to the bottom of the environment of such an illuminance, the lack of brightness of the screen by the reflective display using outdoor daylight will be compensated according to concomitant use of the transparency display using the illumination light. In addition, under the dark environment where outdoor daylight is not obtained, it becomes only the transparency display using the illumination light.

[0081] That is, under the environment where the outdoor daylight of sufficient brightness is obtained, when the reflective display which uses outdoor daylight, without carrying out outgoing radiation of the illumination light from said lighting means 20 is performed and the brightness of outdoor daylight runs short, this liquid crystal display carries out outgoing radiation of the illumination light from said lighting means 20, and screen intensity is compensated with it.

[0082] When the screen intensity of the liquid crystal display component 1 in this liquid crystal display is explained, the suitable screen intensity of a liquid crystal display changes with environmental illuminances, and its same screen intensity is also too dark in being too dazzling in a screen depending on an environmental illuminance.

[0083] therefore -- this liquid crystal display -- the direct sunlight of a summer -- so that the suitable screen intensity which is not too dazzling may be obtained also under the environment of the high illuminance exceeding the following 100000 luxs Mainly with the reflection factor (reflection factor of the reflective film 28 on two or more **** 26 of a transparent material 24) of the outdoor daylight of said lighting means 20, and the permeability of the light of the liquid crystal display component 1 The reflection factor (ratio with the outgoing radiation luminous intensity which it is reflected with the lighting means 20 against the reinforcement of the outdoor daylight which carries out incidence from the front of the liquid crystal display component 1, and carries out outgoing radiation ahead [of said liquid crystal display component 1]) of the decided liquid crystal display The reflected light of the outdoor daylight which sets up low compared with the usual reflective mold liquid crystal display only using the reflected light of outdoor daylight, and carries out incidence from the front of the liquid crystal display component 1, and is reflected by said lighting means 20, Screen intensity by both illumination light in which said lighting means 20 carries out outgoing radiation (however, when an environmental illuminance is almost 0 lux) He is trying for said lighting means 20 to control the brightness of the illumination light which carries out outgoing radiation according to an environmental illuminance so that the screen intensity only by the illumination light in which the lighting means 20 carries out outgoing radiation turns into suitable screen intensity according to an environmental illuminance.

[0084] the suitable screen intensity according to an environmental illuminance -- for example, a streetlight at night -- 20-200 nits with the following environmental illuminances of 50 luxs With an environmental illuminance of 1000 luxs like the interior of a room at the time of making the indoor lighting in day ranges or the night turn on, 30-300 nits, an environmental illuminance of 30000 luxs like the shade of a tree at the time of fine weather -- 400-4000 nits it is -- more preferably It is [in the environmental illuminance of 50 luxs] 1000-3000 nits in the environmental illuminance of 60-200 nits and 30000 luxs at the environmental illuminance of 20-60 nits and 1000 luxs.

[0085] In this example, the brightness of the illumination light in which said lighting means 20 carries out outgoing radiation then, by said lighting control means 33 The screen intensity to an environmental illuminance with the environmental illuminance of 50 luxs 20-300 nits (preferably 20-60 nits), With the environmental illuminance of 1000 luxs, 30-300 nits (preferably 60-200 nits), He is trying to control according to an environmental illuminance to become the brightness expressed with the quadratic function which is satisfied with the environmental illuminance of 30000 luxs of the range of 400-4000 nits (preferably 1000-3000 nits), respectively.

[0086] therefore, the usual reflective mold liquid crystal display with which screen intensity with this liquid crystal display suitable also under a dark environment is obtained and with which it carries out and the reflection factor of a liquid crystal display uses only the reflected light of outdoor daylight -- comparing -- since it may be low -- the direct sunlight of a summer -- the suitable screen intensity which is not too dazzling can be obtained also under the environment of the following high illuminances.

[0087] Moreover, this liquid crystal display can display suitable screen intensity using the illumination

light in which said lighting means 20 carries out outgoing radiation, when an environmental illuminance is almost 0 lux (i.e., even when outdoor daylight is hardly obtained).
[0088] In order that the brightness of said illumination light may just control the brightness of the illumination light which carries out outgoing radiation from said lighting means by the condition that the screen intensity by both the reflected light of outdoor daylight and said illumination light should just be the value which becomes suitable brightness to an environmental illuminance, there may be little power consumption of said lighting means 20.
[0089] Therefore, this liquid crystal display can have little power consumption, it can end, and, moreover, suitable screen intensity can be obtained from a low illuminance to that environmental illuminance in the environment of the illuminance range where a high illuminance is large.
[0090] In addition, in an environmental illuminance higher than an indoor illuminance (near 1000 lux), as for said lighting control means 33, it is desirable to control by the conditions which mentioned the brightness of the illumination light above, and it can obtain more suitable screen intensity to the environmental illuminance by doing in this way under the environment of an illuminance higher than an indoor illuminance.
[0091] In this case, in the environmental illuminance below an indoor illuminance, it may be made to keep the brightness of said illumination light constant, and even in such a case, if the brightness of the illumination light is set up so that the above-mentioned conditions may be satisfied, suitable screen intensity can be obtained to an environmental illuminance under the environment below an indoor illuminance.
[0092] However, as for said lighting control means 33, it is desirable to control the brightness of the illumination light also with the environmental illuminance below an indoor illuminance to become low continuously in connection with an environmental illuminance becoming low, and it can lessen power consumption of said lighting means 20 further while it makes more suitable screen intensity under the environment of the illuminance range lower than an indoor illuminance by doing in this way.
[0093] Moreover, since the light source control section 35 which controls burning and its outgoing radiation brightness of the light source 21 by the above-mentioned example based on the environmental illuminance measured in said lighting control means 33 by the illuminance detector 34 which measures an environmental illuminance, and this illuminance detector 34 constitutes, the brightness of said illumination light can be controlled according to a actual environmental illuminance, and suitable screen intensity can be obtained to that environmental illuminance.
[0094] In the above-mentioned example, a lighting means 20 to arrange behind the liquid crystal display component 1 Furthermore, the light source 21, The illumination light from said light source 21 The outgoing radiation side which is drawn and carries out outgoing radiation towards the liquid crystal display component 1 The transparent material 24 in which a different outdoor daylight reflector (reflective film 28 formed on two or more **** 22b of a transparent material 24) from said outgoing radiation side for making said liquid crystal display component 1 turn and reflect the outdoor daylight which carries out incidence from (two or more level difference sides 27 of a transparent material 24) and the front of said liquid crystal display component 1 was formed Since it is considering as the configuration which it had, it is possible to choose uniquely the rate of outgoing radiation of the illumination light from said outgoing radiation side (level difference side 27) and the reflection factor of the outdoor daylight by said outdoor daylight reflector (reflective film 28), respectively.
[0095] Therefore, while making high the rate of outgoing radiation of the illumination light from said outgoing radiation side (level difference side 27), and only raising and its part making low the luminescence brightness of said light source 21 for the utilization effectiveness of the illumination light from said light source 21 and reducing power consumption more, the reflection factor of the outdoor daylight in said reflector 24 can be set up so that the reflection factor of a liquid crystal display may become a desired value.
[0096] And since said transparent material 24 forms that front face in a stairway shaped surface and forms the reflective film 28 over that whole surface on two or more of those **** 26, it can reflect without futility most outdoor daylight which this transparent material 24 has a reflection property

equivalent to the usual reflecting plate which has a flat reflector, therefore carries out incidence from the front.

[0097] In addition, refracting interface 31b of two or more incidence sections 31 of the optical member 30 which is a front member of said lighting means 20 If it is good also as a condensing refracting interface of the shape not only of a straight-line side with a fixed angle of inclination as shown in drawing 3 and drawing 4 but a curved surface and does in this way Since the light which is incorporated from plane-of-incidence 31a of said incidence section 31, and is refracted towards the direction of a front face by said refracting interface 31b condenses in the predetermined direction according to a condensing operation of said refracting interface 31b which is a condensing curved-surface-like refracting interface, Outgoing radiation of the illumination light and the reflected light of luminance distribution with stronger directivity can be carried out.

[0098] Moreover, although the reflecting plate 29 is formed in the tooth back of the transparent material 24 which constitutes said lighting means 20 in this example, when total reflection of most light which goes to the transparent material tooth back of the illumination light which carried out incidence to the transparent material 24 from that incidence end face 25 can be carried out by the interface of the tooth back of a transparent material 24, and the open air (air), said reflecting plate 29 may be omitted.

[0099] Furthermore, although the reflective film 28 is formed on **** 26 of the plurality of the stairway shaped surface of said transparent material 24 instead, two or more **** 26 of said stairway shaped surface are made to penetrate, and you may make it reflect the outdoor daylight which prepares the reflective film in the whole tooth back of said transparent material 24, makes a transparent material tooth back an outdoor daylight reflector, and carries out incidence from the front in the above-mentioned example according to the outdoor daylight reflector on the tooth back of a light guide plate.

[0100] Moreover, what made two or more of the end faces the incidence end face which incorporates the illumination light from the light source 21, respectively is sufficient as said transparent material 24. For example, what is necessary is to make the front face of this transparent material 24 into the stairway shaped surface which becomes low gradually toward the pars intermedia of a transparent material 24 from both incidence end faces, to make the incidence end face of said both counter, respectively, and just to arrange the light source 21, when [of a transparent material 24] making two end faces of an opposite hand into an incidence end face mutually, respectively.

[0101] Furthermore, the light sources 21 of said lighting means 20 may be the LED array where what [not only] uses a fluorescent lamp 22 but two or more LED (light emitting diode) was aligned, the EL (electroluminescence) panel, etc.

[0102] By the way, the transparency path of the light at the time of the reflective display using outdoor daylight differs from the transparency path of the light at the time of the transparency display using the illumination light, and when it is a reflective display, the above-mentioned liquid crystal display The outdoor daylight which carried out incidence from the front of the liquid crystal display component 1 penetrates said liquid crystal display component 1, and is reflected by the lighting means 20 in back. To that reflected light penetrating said liquid crystal display component 1 again, and carrying out outgoing radiation ahead, incidence is carried out to said liquid crystal display component 1 from that tooth back, and the illumination light from said lighting means 20 penetrates this liquid crystal display component 1, and carries out outgoing radiation of the time of a transparency display ahead.

[0103] Therefore, said liquid crystal display component 1 is with the time of the reflective display using outdoor daylight, and the transparency display using the illumination light, and shows a different electrical-potential-difference-permeability property.

[0104] Drawing 6 shows the electrical-potential-difference-permeability property at the time of the reflective display of said liquid crystal display component 1, and a transparency display, a continuous line is an electrical-potential-difference-permeability property at the time of a reflective display, and a broken line is an electrical-potential-difference-permeability property at the time of a transparency display.

[0105] In addition, the electrical-potential-difference-permeability property shown in drawing 6 has the highest permeability when being in a non-electric-field condition, i.e., the initial orientation condition

that the liquid crystal molecule lodged most to the 2 or 3rd page of a substrate, and is the property of the TN liquid crystal display device in the no MARIHO wye mode in which permeability falls [permeability] in connection with carrying out orientation so that a liquid crystal molecule may start to the 2 or 3rd page of a substrate with an electrode 4 and the electrical potential difference impressed among eight.

[0106] Thus, since said liquid crystal display component 1 shows an electrical-potential-difference-permeability property which is different in the time of a reflective display and a transparency display, the permeability to an electrode 4 and the driver voltage impressed among eight will differ in the time of said reflective display and said transparency display, and the display grace at the time of a reflective display and the display grace at the time of the transparency display using the illumination light will differ in it.

[0107] In this liquid crystal display, then, the driver voltage of two or more values selectively impressed between the electrode 4 of the liquid crystal display component 1, and 8 by said display drive system 40 The permeability of two or more gradation which controls by the time of said reflective display and said transparency display according to an individual, and corresponds to the driver voltage of two or more values at the time of said reflective display, respectively, It is made to make almost equal the permeability of two or more gradation which corresponds to the driver voltage of two or more values at the time of said transparency display, respectively for said two or more gradation of every.

[0108] It constitutes from this example so that said display drive system 40 controls based on the electrical-potential-difference-permeability property at the time of the transparency display of the driver voltage of two or more of said values at the time of said transparency display of said liquid crystal display component 1 and may control based on the difference of the electrical-potential-difference-permeability property at the time of the transparency display of the driver voltage of two or more of said values at the time of said reflective display of said liquid crystal display component 1, and the electrical-potential-difference-permeability property at the time of a reflective display.

[0109] If the configuration of said display drive system 40 is explained, this display drive system 40 consists of the gate side actuation circuit 41, a data side actuation circuit 42, and a gamma amendment potential supply means 43 to supply two or more gamma amendment potentials which are equivalent to the permeability of two or more gradation, respectively to said data side actuation circuit 42, as shown in drawing 1 .

[0110] And he is trying to supply two or more gamma amendment potentials of a value which is different in the time of said reflective display and said transparency display, respectively from the aforementioned gamma amendment potential supply means 43 to said data side actuation circuit 42 in this example.

[0111] The aforementioned gamma amendment potential supply means 43 is constituted by the echo/transparency judging section 44 which judges the exception of said transparency display to be said reflective display, and the gamma amendment potential output section 45 supply either of two or more gamma amendment potentials at the time of said reflective display, and two or more gamma amendment potentials at the time of said transparency display to said data side actuation circuit 15 based on the judgment result of this echo/transparency judging section 44.

[0112] Said echo/transparency judging section 44 is interlocked with the outgoing radiation of the illumination light from said lighting means 20, and judges the exception of said transparency display to be said reflective display.

[0113] In this example, namely, the light source control section 35 of said lighting control means 33 When the light source 21 of said lighting means 20 is made to turn on, a light source burning signal is outputted to said echo/transparency judging section 44. It constitutes so that a light source putting-out-lights signal may be outputted to said echo/transparency judging section 44, when said light source 21 is made to switch off. When said echo/transparency judging section 44 is inputted into said light source burning signal, a transparency display judging signal is outputted to the aforementioned gamma amendment potential output section 45, and when said light source putting-out-lights signal is inputted, it constitutes so that a reflective display judging signal may be outputted to the aforementioned gamma

amendment potential output section 45.
[0114] Moreover, as shown in drawing 2 , the aforementioned gamma amendment potential output section 45 the configuration Either of said two kinds of two or more reference potentials which the reference potential generating circuit 46 which generates two kinds of two or more reference potentials, and this reference potential generating circuit 46 generate is chosen based on the judgment result of said echo/transparency judging section 44. It is constituted by the potential selection circuitry 47 which supplies two or more of the selected potentials to said data side actuation circuit 42 as said two or more gamma amendment potentials.
[0115] gamma amendment potential output section 45 shown in drawing 2 is what supplies gamma amendment potential for 11 gradation of gradation 0 - gradation 10 to said data side actuation circuit 42. Said reference potential generating circuit 46 1st reference potential generating section 46a which generates 11 steps of reference potentials (henceforth a reflective display reference potential) for obtaining gamma amendment potential for 11 gradation at the time of said reflective display, and supplies each of that reference potential to said potential selection circuitry 47, 11 steps of reference potentials (henceforth a transparency display reference potential) for obtaining gamma amendment potential for 11 gradation at the time of said transparency display are generated, and it consists of the 2nd reference potential generating section 46b which supplies each of that reference potential to said potential selection circuitry 47.
[0116] And in this example, in order to make almost equal the permeability of the gradation 0 at the time of a reflective display - gradation 10, and the permeability of the gradation 0 at the time of a transparency display - gradation 10 for every gradation 11 steps of transparency display reference potentials which said 2nd reference potential generating section 46b generates It sets up based on the electrical-potential-difference-permeability property at the time of the transparency display of said liquid crystal display component 1. 11 steps of reflective display reference potentials which said 1st reference potential generating section 46a generates are set up based on the difference of the electrical-potential-difference-permeability property at the time of the transparency display of said liquid crystal display component 1, and the electrical-potential-difference-permeability property at the time of a reflective display.
[0117] Namely, the driver voltage for obtaining permeability lower than about 30%, when it is a property as the electrical-potential-difference-permeability property at the time of the reflective display of said liquid crystal display component 1 and a transparency display showed to drawing 6 , The driver voltage for obtaining permeability higher than about 60% has a direction lower than the time of a transparency display at the time of a reflective display, and the driver voltage for obtaining the permeability of the range [higher than about 30%] lower than about 60% has a direction slightly higher than the time of a transparency display at the time of a reflective display.
[0118] Therefore, the reference potential for obtaining gamma amendment potential of each gradation with permeability lower than about 30% among 11 steps of reflective display reference potentials which said 1st reference potential generating section 46a generates in this example, The reference potential for obtaining gamma amendment potential of each gradation with permeability higher than about 60%, respectively Rather than the transparency display reference potential for obtaining gamma amendment potential of the same gradation which said 2nd reference potential generating section 46b generates The reflective display reference potential for setting up low only the value according to the difference of said electrical-potential-difference-permeability property, and obtaining gamma amendment potential of each gradation of the range in which permeability is higher than about 30%, and lower than about 60% Rather than the transparency display reference potential for obtaining gamma amendment potential of the same gradation which said 2nd reference potential generating section 26b generates, only the value according to the difference of said electrical-potential-difference-permeability property is set up highly.
[0119] As shown in drawing 6 , in addition, the driver voltage for obtaining about 30% of permeability and about 60% of permeability gamma amendment potential of the gradation whose permeability is about 30% among the reflective display reference potentials which said 1st reference potential generating section 46a generates since it is almost the same also at the time of a reflective display and a

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transparency display, The reference potential for obtaining gamma amendment potential of the gradation whose permeability is about 60% is the same as the transparency display reference potential for obtaining gamma amendment potential of the same gradation which said 2nd reference potential generating section 46b generates, and good.

[0120] 11 steps of reflective display reference potentials which 1st reference potential generating section 46a of said potential generating circuit 46 generates are supplied to the input-side terminals A1-K1 of said potential selection circuitry 47, respectively, and 11 steps of transparency display reference potentials which 2nd reference potential generating section 46b generates are supplied to the input-side terminals A2-K2 of said potential selection circuitry 47, respectively.

[0121] Moreover, said potential selection circuitry 47 has every one output terminal A-K to the input terminals A1, A2-K1 of every a couple with which the reflective display reference potential and transparency display reference potential of each phase are supplied, and K2, respectively. Based on echo/transparency judging signal from said echo/transparency judging section 44, when the signal is a reflective display judging signal The reflective display reference potential of each phase supplied to the input-side terminals A1-K1, respectively is outputted from said output terminal A-K. When echo/transparency judging signal from said echo/transparency judging section 44 is a transparency display judging signal, the transparency display reference potential of each phase supplied to the input-side terminals A2-K2, respectively is outputted from said output terminal A-K.

[0122] The reference potential of each phase outputted from each output terminal A-K of said this potential selection circuitry 47 is amplified through an operational amplifier 48, respectively, and is supplied to said data side actuation circuit 42 as gamma amendment potential for 11 gradation of V0-V10.

[0123] And as mentioned above, said data side actuation circuit 42 chooses gamma amendment potential corresponding to the image data supplied from the outside from said gamma amendment potentials for 11 gradation of V0-V10 supplied from the aforementioned gamma amendment potential supply means 43, and supplies the data signal of the potential to two or more data lines of the liquid crystal display component 1.

[0124] Therefore, the driver voltage of two or more values selectively impressed by the above-mentioned display drive system 40 between the electrode 4 of the liquid crystal display component 1 and 8 At the time of the transparency display which it is an electrical potential difference corresponding to gamma amendment potential obtained from the above-mentioned reflective display reference potential at the time of the reflective display using outdoor daylight, and uses the illumination light It is an electrical potential difference corresponding to gamma amendment potential obtained from the above-mentioned transparency display reference potential. The sake, The permeability of two or more gradation which corresponds to the driver voltage of two or more values at the time of said reflective display, respectively, and the permeability of two or more gradation which corresponds to the driver voltage of two or more values at the time of said transparency display, respectively can be made almost equal for said two or more gradation of every.

[0125] The above-mentioned liquid crystal display namely, the driver voltage of two or more of said values selectively impressed between the electrode 4 of said liquid crystal display component 1, and 8 by said display drive system 40 The permeability of two or more gradation which controls by the time of said reflective display and said transparency display according to an individual, and corresponds to the driver voltage of two or more values at the time of said reflective display, respectively, For said two or more gradation of every, are the bottom almost equally, and according to this liquid crystal display, the permeability of two or more gradation which corresponds to the driver voltage of two or more values at the time of said transparency display, respectively The display of the grace almost same also at the time of the reflective display using outdoor daylight and the transparency display using the illumination light can be obtained.

[0126] In the above-mentioned liquid crystal display said display drive system 40 and the driver voltage of two or more values at the time of said transparency display It controls based on the electrical-potential-difference-permeability property at the time of the transparency display of the liquid crystal

display component 1. Since it constitutes so that the driver voltage of two or more values at the time of said reflective display may be controlled based on the difference of the electrical-potential-difference-permeability property at the time of the transparency display of said liquid crystal display component 1, and the electrical-potential-difference-permeability property at the time of a reflective display, Display grace at the time of a reflective display can be made almost equal to the display grace at the time of a transparency display, and the high display of contrast can be obtained highly [the brightness of ******] also at the time of a reflective display and a transparency display.

[0127] Namely, if the electrical-potential-difference-permeability property at the time of the reflective display of said liquid crystal display component 1 and a transparency display is compared, as shown in drawing 6 The direction of the electrical-potential-difference-permeability property at the time of a transparency display is [therefore] the property that the high display of contrast is obtained highly [the brightness of ******]. As mentioned above The driver voltage of two or more values at the time of a transparency display is controlled based on the electrical-potential-difference-permeability property at the time of the transparency display of said liquid crystal display component 1. If the driver voltage of two or more values at the time of a reflective display is controlled based on the difference of the electrical-potential-difference-permeability property at the time of the transparency display of said liquid crystal display component 1, and the electrical-potential-difference-permeability property at the time of a reflective display The high display of contrast can be obtained highly [the brightness of ******] also at the time of a reflective display and a transparency display.

[0128] Moreover, although the liquid crystal display component 1 used with the above-mentioned liquid crystal display is an active-matrix liquid crystal display component The gate side actuation circuit 41 where said display drive system 40 was connected to said two or more gate lines in the above-mentioned example, It consists of a data side actuation circuit 42 connected to said two or more data lines, and a gamma amendment potential supply means 43 to supply two or more gamma amendment potentials which are equivalent to the permeability of two or more of said gradation, respectively to said data side actuation circuit 42. The aforementioned gamma amendment potential supply means 43 supplies two or more gamma amendment potentials of a value which is different in the time of said reflective display and said transparency display, respectively to said data side actuation circuit 42. Said data side actuation circuit 42 chooses gamma amendment potential corresponding to image data from said two or more gamma amendment potentials supplied from the aforementioned gamma amendment potential supply means 43. Since it is considering as the configuration which supplies the data signal of the potential to said data line, it can be made almost the same also at the time of the reflective display which uses outdoor daylight for the display grace of said active-matrix liquid crystal display component 1, and the transparency display using the illumination light.

[0129] And echo/transparency judging section 44 which judges the exception of said transparency display for the aforementioned gamma amendment potential supply means 43 in the above-mentioned example to be said reflective display, Since gamma amendment potential output section 45 which supplies either of two or more gamma amendment potentials at the time of said reflective display and two or more gamma amendment potentials at the time of said transparency display to said data side actuation circuit 42 constitutes based on the judgment result of this echo/transparency judging section 44, According to the exception of the transparency display with a reflective display, gamma amendment potential supplied to said data side actuation circuit 42 can be switched automatically.

[0130] Furthermore, in the above-mentioned example, as shown in drawing 2 , the aforementioned gamma amendment potential output section 45 Either of said two kinds of two or more reference potentials which the reference potential generating circuit 46 which generates two kinds of two or more reference potentials, and this reference potential generating circuit 46 generate is chosen based on the judgment result of said echo/transparency judging section 44. Since the potential selection circuitry 47 which supplies two or more of the selected potentials to said data side actuation circuit 42 as said two or more gamma amendment potentials constitutes, gamma amendment potential supplied to said data side actuation circuit 42 can be certainly switched according to the exception of the transparency display with a reflective display.

[0131] Moreover, since it constitutes from an above-mentioned example so that said echo/transparency judging section 44 may be interlocked with the outgoing radiation of the illumination light from said lighting means 20 and the exception of said transparency display may be judged to be said reflective display, the exception of the transparency display with a reflective display can be judged with sufficient dependability, and gamma amendment potential at the time of the display can be supplied to said data side actuation circuit 42.
[0132] In addition, the display drive system 40 of said liquid crystal display component 1 The driver voltage of two or more values at the time of a reflective display is controlled based on the electrical-potential-difference-permeability property at the time of the reflective display of the liquid crystal display component 1. By constituting so that the driver voltage of two or more values at the time of a transparency display may be controlled based on the difference of the electrical-potential-difference-permeability property at the time of the reflective display of said liquid crystal display component 1, and the electrical-potential-difference-permeability property at the time of a transparency display, and doing in this way Display grace at the time of the transparency display using the illumination light can be made almost equal to the display grace at the time of the reflective display using outdoor daylight.
[0133] Moreover, although gamma amendment potential at the time of the reflective display outputted from the above-mentioned gamma amendment potential output section 45 and gamma amendment potential at the time of a transparency display are mutually changed in almost all gradation in the above-mentioned example Influencing greatly the display grace of the liquid crystal display component 1 Since it is mainly the brightness of ******, even if it is good even if gamma amendment potential at the time of a transparency display is the same as gamma amendment potential at the time of the reflective display corresponding to the permeability of the tonal range of medium gradation to dark gradation and such, display grace at the time of a reflective display and a transparency display can be made almost the same.

[0134] Furthermore, although it judges with a transparency display and he is trying to switch gamma amendment potential to the potential at the time of a transparency display in the above-mentioned example when the illumination light carries out outgoing radiation from said lighting means 20 Both brightness of the illumination light in which said lighting means 20 carries out outgoing radiation to an environmental illuminance is measured, when the brightness ratio of the illumination light to an environmental illuminance becomes beyond a predetermined value, it judges with a transparency display, and you may make it switch gamma amendment potential to the potential at the time of a transparency display.
[0135] When the light used for a display will mainly be outdoor daylight when there are more amounts of outgoing radiation of the reflected light of outdoor daylight than the illumination light that is, if it does in this way The liquid crystal display component 1 is driven using gamma amendment potential at the time of a reflective display, and when there are more amounts of outgoing radiation of the illumination light than the reflected light of outdoor daylight (i.e., when the light used for a display is mainly illumination light), the liquid crystal display component 1 can be driven using gamma amendment potential at the time of a transparency display.
[0136] Moreover, the lighting means 20 used with the liquid crystal display of the above-mentioned example The light source 21, The illumination light from said light source 21 The outgoing radiation side which is drawn and carries out outgoing radiation towards the liquid crystal display component 1 The transparent material 24 in which a different outdoor daylight reflector (reflective film 28 formed on two or more **** 22b of a transparent material 24) from said outgoing radiation side for making said liquid crystal display component 1 turn and reflect the outdoor daylight which carries out incidence from (two or more level difference sides 27 of a transparent material 24) and the front of said liquid crystal display component 1 was formed Although it is the thing of a configuration of having had If said lighting means 20 consists of a reflective means to reflect the outdoor daylight which carries out incidence of the illumination light to a means to irradiate the liquid crystal display component 1, from the front of said liquid crystal display component 1, and to irradiate the reflected light at said liquid crystal display component 1 For example, what has arranged the transflective reflecting plate in the front

face of the lighting panel which carries out outgoing radiation of the illumination light may be used.
[0137]
[Effect of the Invention] Although the liquid crystal display of this invention is the thing of the 2-way display mold which displays both the reflective display using outdoor daylight, and the transparency display using the illumination light The permeability of two or more gradation which controls by the time of a reflective display and a transparency display the driver voltage of two or more of said values selectively impressed to inter-electrode [of a liquid crystal display component] according to an individual, and corresponds to the driver voltage of two or more values at the time of said reflective display, respectively, Since the permeability of two or more gradation which corresponds to the driver voltage of two or more values at the time of said transparency display, respectively is made almost equal for said two or more gradation of every, the display of the grace almost same also at the time of the reflective display using outdoor daylight and the transparency display using the illumination light can be obtained.
[0138] In the liquid crystal display of this invention said display drive system For example, the driver voltage of two or more of said values at the time of said transparency display is controlled based on the electrical-potential-difference-permeability property at the time of the transparency display of said liquid crystal display component. By doing in this way that what is necessary is just to constitute so that the driver voltage of two or more of said values at the time of said reflective display may be controlled based on the difference of the electrical-potential-difference-permeability property at the time of the transparency display of said liquid crystal display component, and the electrical-potential-difference-permeability property at the time of a reflective display Display grace at the time of a reflective display can be made almost equal to the display grace at the time of a transparency display.
[0139] The display drive system of said liquid crystal display component moreover, the driver voltage of two or more of said values at the time of said reflective display It controls based on the electrical-potential-difference-permeability property at the time of the reflective display of said liquid crystal display component. By constituting so that the driver voltage of two or more of said values at the time of said transparency display may be controlled based on the difference of the electrical-potential-difference-permeability property at the time of the reflective display of said liquid crystal display component, and the electrical-potential-difference-permeability property at the time of a transparency display, and doing in this way Display grace at the time of a transparency display can be made almost equal to the display grace at the time of a reflective display.
[0140] In the liquid crystal display of this invention said liquid crystal display component to the inner surface of the substrate of one of these Two or more pixel electrodes, Two or more thin film transistors connected to these pixel electrodes, respectively, Two or more gate lines and data lines which were connected to said two or more thin film transistors, respectively are prepared. When it is the active-matrix liquid crystal display component with which the counterelectrode which counters said two or more pixel electrodes was prepared in the inner surface of the substrate of another side, said display drive system The gate side actuation circuit connected to said two or more gate lines, and the data side actuation circuit connected to said two or more data lines, It consists of a gamma amendment potential supply means to supply two or more gamma amendment potentials which are equivalent to the permeability of two or more of said gradation, respectively to said data side actuation circuit. The aforementioned gamma amendment potential supply means supplies two or more gamma amendment potentials of a value which is different in the time of said reflective display and said transparency display, respectively to said data side actuation circuit. Said data side actuation circuit chooses gamma amendment potential corresponding to image data from said two or more gamma amendment potentials supplied from the aforementioned gamma amendment potential supply means. The configuration which supplies the data signal of the potential to said data line, then by being good and constituting said display drive system in this way It can be made almost the same also at the time of the reflective display which uses outdoor daylight for the display grace of said active-matrix liquid crystal display component, and the transparency display using the illumination light.
[0141] In this case, echo/transparency judging section in which the aforementioned gamma amendment

h g cg b eb cg e e

potential supply means judges the exception of said transparency display to be said reflective display, When it is desirable for gamma amendment potential output section which supplies either of two or more gamma amendment potentials at the time of said reflective display and two or more gamma amendment potentials at the time of said transparency display to said data side actuation circuit to constitute based on the judgment result of this echo/transparency judging section and it does in this way According to the exception of the transparency display with a reflective display, gamma amendment potential supplied to said data side actuation circuit can be switched automatically.

[0142] Furthermore, the reference potential generating circuit where the aforementioned gamma amendment potential output section generates two kinds of two or more reference potentials, Either of said two kinds of two or more reference potentials which this reference potential generating circuit generates is chosen based on the judgment result of said echo/transparency judging section. When it is desirable that the potential selection circuitry supplied to said data side actuation circuit as said two or more gamma amendment potentials constitutes and it carries out two or more of the selected potentials in this way gamma amendment potential supplied to said data side actuation circuit can be certainly switched according to the exception of the transparency display with a reflective display.

[0143] Moreover, as for said echo/transparency judging section, it is desirable to constitute so that the outgoing radiation of the illumination light from said lighting means may be interlocked with and the exception of said transparency display may be judged to be said reflective display, by doing in this way, the exception of the transparency display with a reflective display can be judged with sufficient dependability, and gamma amendment potential at the time of the display can be supplied to said data side actuation circuit.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] A liquid crystal display component with which an electrode was prepared in an inner surface of a substrate of a couple which counters on both sides of a liquid crystal layer, respectively, A lighting means to turn to said liquid crystal display component outdoor daylight which carries out incidence, and to reflect from the front of said liquid crystal display component while being arranged behind said liquid crystal display component and turning and carrying out outgoing radiation of the illumination light to said liquid crystal display component, It has a display drive system which impresses driver voltage of two or more values to inter-electrode [of said liquid crystal display component] selectively. A reflective display which reflect outdoor daylight which carries out incidence from the front of said liquid crystal display component with said lighting means, and the outgoing radiation of the reflected light is made to carry out ahead [of said liquid crystal display component], and is displayed, While displaying both transparency displays which carry out outgoing radiation of the illumination light from said lighting means, and the outgoing radiation of the light is made to carry out ahead [of said liquid crystal display component], and are displayed Driver voltage of two or more of said values selectively impressed to inter-electrode [of said liquid crystal display component] by said display drive system Permeability of two or more gradation which controls by the time of said reflective display and said transparency display according to an individual, and corresponds to driver voltage of two or more values at the time of said reflective display, respectively, A liquid crystal display characterized by making almost equal permeability of two or more gradation which corresponds to driver voltage of two or more values at the time of said transparency display, respectively for said two or more gradation of every.
[Claim 2] Said display drive system is the liquid crystal display according to claim 1 characterized by to control driver voltage of two or more of said values at the time of said transparency display based on an electrical-potential-difference-permeability property at the time of a transparency display of said liquid crystal display component, and to control driver voltage of two or more of said values at the time of said reflective display based on a difference of an electrical-potential-difference-permeability property at the time of a transparency display of said liquid crystal display component, and an electrical-potential-difference-permeability property at the time of a reflective display.
[Claim 3] Said display drive system is the liquid crystal display according to claim 1 characterized by to control driver voltage of two or more of said values at the time of said reflective display based on an electrical-potential-difference-permeability property at the time of a reflective display of said liquid crystal display component, and to control driver voltage of two or more of said values at the time of said transparency display based on a difference of an electrical-potential-difference-permeability property at the time of a reflective display of said liquid crystal display component, and an electrical-potential-difference-permeability property at the time of a transparency display.
[Claim 4] Said liquid crystal display component to an inner surface of substrate of one of these Two or more pixel electrodes, Two or more thin film transistors connected to these pixel electrodes, respectively, Two or more gate lines and data lines which were connected to said two or more thin film transistors, respectively are prepared. It is the active-matrix liquid crystal display component with which

a counterelectrode which counters said two or more pixel electrodes was prepared in an inner surface of a substrate of another side. Said display drive system A gate side actuation circuit connected to said two or more gate lines, and a data side actuation circuit connected to said two or more data lines, It has permeability of two or more of said gradation from a gamma amendment potential supply means to supply two or more gamma amendment potentials which correspond, respectively in said data side actuation circuit. The aforementioned gamma amendment potential supply means Two or more gamma amendment potentials of a value which is different in the time of said reflective display and said transparency display, respectively are supplied to said data side actuation circuit. Said data side actuation circuit A liquid crystal display according to claim 1 to 3 characterized by choosing gamma amendment potential corresponding to image data from said two or more gamma amendment potentials supplied from the aforementioned gamma amendment potential supply means, and supplying a data signal of the potential to said data line.

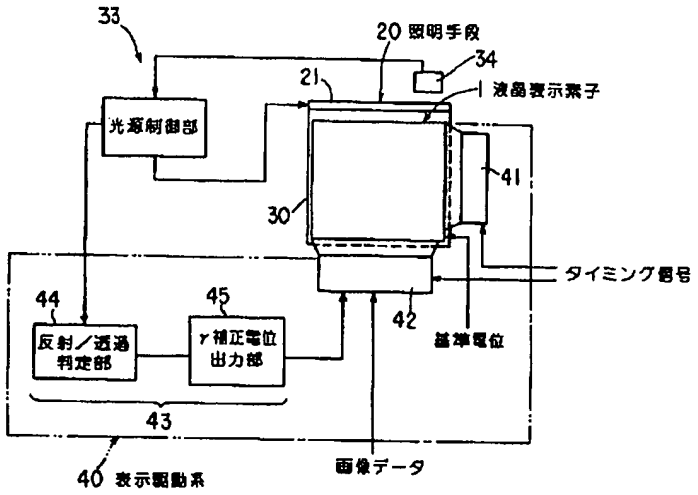
[Claim 5] The aforementioned gamma amendment potential supply means is the liquid crystal display according to claim 4 carry out having become from the echo/transparency judging section which judges the exception of said transparency display to be said reflective display, and the gamma amendment potential output section supply either of two or more gamma amendment potentials at the time of said reflective display, and two or more gamma amendment potentials at the time of said transparency display to said data side actuation circuit based on the judgment result of this echo/transparency judging section as the description.

[Claim 6] The aforementioned gamma amendment potential output section is the liquid crystal display according to claim 5 characterized by to consist of a reference potential generating circuit which generates two kinds of two or more reference potentials, and a potential selection circuitry which chooses either of two kinds of two or more of said reference potentials which this reference potential generating circuit generates based on a judgment result of said echo/transparency judging section, and supply two or more of those selected potentials to said data side actuation circuit as two or more of said gamma amendment potentials.

[Claim 7] Said echo/transparency judging section is a liquid crystal display according to claim 5 or 6 characterized by for outgoing radiation of illumination light from said lighting means being interlocked with, and judging an exception of said transparency display to be said reflective display.

[Translation done.]

【図1】



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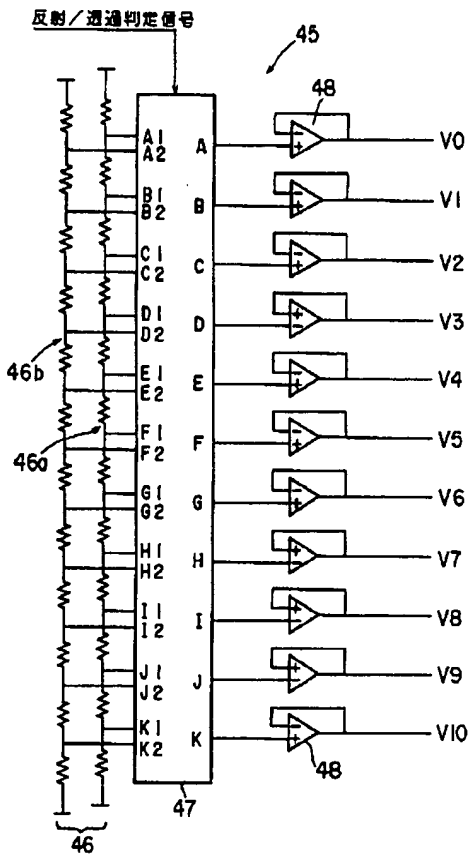

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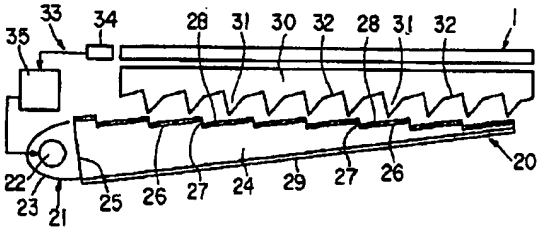

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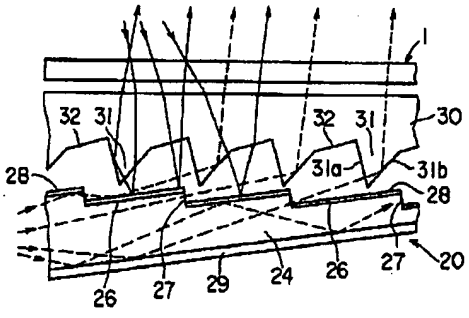

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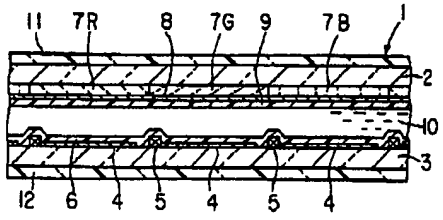

【図6】